POSTURE HEARING WITH THE SCIENCE ADVISOR TO THE PRESIDENT

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES

ONE HUNDREDTH CONGRESS

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POSTURE HEARING WITH THE SCIENCE ADVISOR TO THE PRESIDENT

WEDNESDAY, JANUARY 28, 1987

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The committee met, pursuant to call, at 10:10 a.m., in room 2318, Rayburn House Office Building, Hon. Robert A. Roe (chairman of the committee) presiding.

Mr. ROE. The committee will come to order.

For the benefit of the Members, before we begin our posture hearing today, at 11:38 we will cease our deliberations and hold 73 seconds of silence in commemoration of the day of the accident of the shuttle and the seven astronauts, American heroes.

For the benefit, again, of the Democratic Members, the organizational meeting will be held at 4:00, and a notice has been sent to everyone's office; and at 2 o'clock, when the House convenes, for the benefit of all Members, Manuel and myself have introduced a resolution in commemoration of this important day and I would recommend the Members be on the Floor to participate in that activity.

For the sake of time this morning, I have a short opening statement to lay out what we're going to review today, and I'll welcome our guests and our witness, and then I'll defer to the distinguished ranking Republican Member, Congressman Manuel Lujan. If anyone else has opening statements, they will be entered in the record following Manuel's presentation.

Having said that, today our committee begins the process of reviewing the President's budget proposals for research and development in fiscal year 1988. To help us in that review, we are pleased to welcome the science and technology advisor to the President, Dr. William Graham, who also serves as director of the Office of Science and Technology Policy in the White House.

Since its inception, this committee has been a strong supporter of the Nation's activities in the field of research and development, and we have, ever since Sputnik, supported NASA's efforts to place the United States in a leadership position in space; we have, especially since the energy crisis in the early seventies, supported a strong and broad-based energy research and development effort; our committee has also been a steady supporter of the NSF's program for support for basic scientific research; and we have given steady support to the R&D programs of the mission agencies within our jurisdiction, including EPA, NOAA, FAA, NBS, and FEMA.

Our role is not to be totally supportive in the sense where there's a difference of opinion in policy and the direction we choose the Nation to go, and that's the purpose, of course, of our review today. As the tragic loss of the space shuttle Challenger only too vividly demonstrated, these programs, in both their day-to-day management and in their long-range plans and policies, must have the steady oversight of the committees of the Congress. As equal partners with the executive branch of the Government, we have the duty of formulating the policies and of seeing that the resources made available to pursue these policies are used effectively.

I am pleased to say that in performing that duty we on this committee have a long tradition of bipartisan cooperation of the strongest order, and it is my intent to carry on that tradition with my good friend, Manuel Lujan.

The new budget proposals include significant increases for some areas of R&D but also some reductions that raise important questions. These budget proposals must be viewed in the light of our current problems and our future direction. What should our posture in space be 5, 10, 20 years from today, or now? How clean will our environment be in the light of the research programs we are carrying out now? What will our competitive posture and our balance of trade be in the year 2000, only 12 years from now, given the science and technology programs now being proposed?

We should not forget that last time our Nation faced a major technological challenge is when Germany's army was thought to be ahead in atomic energy, jet engines, and rockets, we put our scientists to work on solving these advanced technology problems, not on doing more basic research. Does this budget have the right balance between science and engineering, between research and technology? That is one of the areas we will be pursuing today and as we hold our posture hearings.

Next week our subcommittees will begin the review of the R&D budgets of the individual agencies. Today we are glad to have Dr. Graham with us to discuss the overall picture, his observations and views, and the underlying thinking on which these agencies and their budgets are based.

Before I call on you, Dr. Graham, I now defer to the distinguished Republican Member leader of this committee, the Honorable Manuel Lujan.

Mr. LUJAN. Thank you very much, Mr. Chairman, and I would like to join with you in welcoming Dr. Graham to our hearings today. It's nice to have a full-time presidential science advisor with whom to work.

Of course, Dr. Graham is no stranger to this committee. It was one year ago today, in his capacity as Acting NASA administrator, that we sat in my office. We were going to discuss the budget for that day, and together we witnessed the Challenger accident, and, of course, since that day Dr. Graham has had frequent contact with the committee during our investigation of that tragedy.

Mr. Chairman, I look forward to working with Dr. Graham in his new capacity, not only on issues relating to this Nation's space policy but also to our scientific and technological enterprises as well.

Rather than take up more time at this point, Mr. Chairman, I will ask that the remainder of my statement be included in the record so that we can use this morning's time to allow Members the opportunity to visit with Dr. Graham and ask questions of any of the programs that they might have.

Mr. ROE. If there's no objection, so ordered, and if there's no objection, any Member who wishes to place a statement in the record at this point . . . no objection . . . so ordered, it will be done.

Dr. Graham, we want to welcome you, a very distinguished representative of the administration and a very adroit, capable citizen. We're looking forward to your presentation, if you will proceed.

[The biographical sketch of Dr. Graham follows:]

THE WHITE HOUSE

WASHINGTON

DR. WILLIAM R. GRAHAM
Science Adviser to the President
and Director, Office of Science and Technology Policy

Dr. William R. Graham became Science Adviser to the President and Director, Office of Science and Technology Policy, on October 2, 1986. Before assuming the duties of Science Adviser, Dr. Graham was Deputy Administrator of the National Aeronautics and Space Administration, from November 25, 1985.

Dr. Graham served from 1982-85 as Chairman of the General Advisory Committee on Arms Control and Disarmament. In 1980, Dr. Graham served on Presidential candidate Ronald Reagan's Defense Policy Advisory Group and was a member of the President-elect's transition team.

Dr. Graham was a founder and senior executive of R&D Associates, Marina del Rey, California. He worked six years with the RAND Corporation, Santa Monica, California, and for three years was an officer at the Air Force Weapons Laboratory, Kirtland Air Force Base, Albuquerque, New Mexico, directing experimental and theoretical research on strategic system survivability.

Dr. Graham has been a consultant to the Office of the Secretary of Defense and has served on many international and national boards and advisory groups, including the National Academy of Sciences/National Research Council Committee on Undersea Warfare, the Air Force Science Advisory Board Task Force on Manned Strategic System Vulnerability, the U.S.-U.K. Joint Working Group on Atomic Weapons, the Defense Nuclear Agency Scientific Advisory Group on Effects, and the Defense Science Board System Vulnerability Task Force and Associated Task Forces.

His memberships in professional and honorary organizations include Tau Beta Pi, the American Institute for Aeronautics and Astronautics, the New York Academy of Sciences, the Council on Foreign Relations, the Board of Directors of the Committee on the Present Danger, the Defense Preparedness Association, the Ethics and Public Policy Center, and the American Association for the Advancement of Science.

Born June 15, 1937, in San Antonio, Texas, Dr. Graham earned a B.S. degree in physics from the California Institute of Technology in 1959. He earned an M.S. degree in engineering science in 1961, and a Ph.D. in electrical engineering in 1963, both from Stanford University. He and his wife, Nina Winter Graham, have two children.

STATEMENT OF WILLIAM R. GRAHAM, SCIENCE ADVISOR TO THE PRESIDENT AND DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. GRAHAM. Thank you, Chairman Roe and distinguished members of the committee.

Having appeared before you several times in other capacities, it's a privilege to be here today as the Director of the Office of Science and Technology Policy. I have a short prepared statement, and then I'll be glad to take any questions.

The President's proposed budget for fiscal year 1988 continues to emphasize maintaining national security, strengthening our economic competitiveness in the international marketplace, improving the quality of life for all Americans, and continuing to pursue the themes of our intellectual and cultural heritages. Obviously, science and technology can contribute to the realization of all of these goals.

The proposed research and development budget reflects the President's commitment to continuing national investment in science and technology. In fiscal year 1988, we propose to obligate a total of $64.8 billion for the conduct of research and development, an increase of 13 percent over the current fiscal year obligation of $57.6 billion. Of this total, $18.2 billion is for non-defense functions and $9.1 billion is for basic research, an overall increase of 4 percent above the 1987 obligation of $8.8 billion for basic research, and that, I might add, in an environment of decreasing budget deficits, a very austere fiscal environment.

Improvement of U.S. economic competitiveness in the world is a major theme of this budget. The administration recognizes that our future position in global markets will depend to a great extent upon, first, the continuing development of the foundation of our science and technology—that is, basic research—second, the allocation of our national resources on a long-term and reliable basis to generate new knowledge; and, third, the effective and timely transfer of new knowledge from our laboratories and universities to our industry, our economy, and our national security.

To this end, specific increases in basic research have been proposed by the President. These include a 17 percent increase in the basic research funding for the National Science Foundation, from $1.36 billion in 1987 to $1.59 billion in fiscal year 1988.

In the area of life sciences, the Department of Health and Human Services R&D activities in 1988 will continue to be funded at stable and sustainable levels. In 1988, the National Institutes of Health will support about 19,100 research project grants, about 560 research centers, and about 10,900 research trainees. In addition, the budget proposes funding for the full, multi-year costs of grant commitments incurred in 1988 and thereafter. This would eliminate annual uncertainties over the level and timing of allotments for grantees and insure proper review of the full cost of funding additional grants. In 1988, the total HHS obligations will approach $6.3 billion, approximately the same level as fiscal year 1987, while outlays will increase by about $200 million in fiscal 1988.

On one particular issue, an urgent health problem faces the Nation in the form of the Acquired Immune Deficiency Syndrome,

AIDS. All aspects of AIDS—prevention through guidance and education, research on AIDS immunization and therapeutics, and treatment of those who are ill—all of these are high priorities in this administration and I'm sure with all of us. The Department of Health and Human Services requested a total of $534 million for fiscal year 1988 of which $121 million is for education and information and $413 million for laboratory and clinical research on AIDS. The total is an increase of 27 percent above the total of $421 million devoted to AIDS in the 1987 budget. We have also requested reprogramming authority to increase AIDS spending in mid-year without the delays normally associated with reprogrammings or budget amendments, to respond rapidly to any breakthroughs in AIDS prevention or treatment that might occur. We will certainly seek and encourage such breakthroughs and other progress in dealing with AIDS.

The President—to change to the global competitiveness issue now—the President has consistently recognized the special role of our universities in generating new knowledge to spark technological innovation and in producing trained men and women to meet the demands of industry and of our Government. From 1982 to 1988, the amount of Federal funds allocated to basic research will have grown by more than 65 percent, and it doesn't stop there. More than half of Federal Government support for basic research goes to universities. Since major Federal support for basic research in physical sciences and engineering is provided through the National Science Foundation, the administration proposes by 1992 in the out-year budgets to triple the NSF's 1980 level of support for basic research—that is, between '80 and '92 the NSF budget will have gone up by a factor of 3 according to the current '88 submission and the outyear figures.

The White House Science Council's report on the health of U.S. colleges and universities issued in February 1986 recommended not only increased Federal support for academic research but also the establishment of more university-based interdisciplinary science and technology centers. In keeping with this recommendation, the fiscal year 1988 budget includes funds to establish up to 15 new interdisciplinary basic research and technology centers through the National Science Foundation. These centers will be modeled after the existing engineering research centers and will emphasize partnership with industry and State and local governments, the partnership that has been established in the engineering research centers.

The Nation's activities depend on the talent and education of our citizens in mathematics, in science, and in engineering. In the last few years, several reports have expressed concern about the quality of our educational system from elementary school through graduate school. "First Lessons" by Secretary of Education Bennett; "A Nation at Risk" by the National Commission on Excellence in Education; the David report on "Renewing U.S. Mathematics"; and the Packard/Bromley report, "A Renewed Partnership," to name only a few.

We are faced with shortages of teachers in some fields now, and by the mid 1990's there could be an across-the-board decrease of 20 percent in the number of bachelor's degrees awarded to all of our

citizens in math, in science, and engineering, in educational fields and others if the enrollments in these fields remain at current percentage levels while the now certain cyclic demographic decrease in the number of people in the college-age group occurs, as it certainly will.

Increased investment in basic research and in transferring that research to industry and to our economy will strengthen and modernize our educational capabilities and help train our next generation while at the same time it's advancing our knowledge and improving our ability to put that knowledge to work. In particular, the National Science Foundation's engineering research centers, new basic science and technology centers, and advanced scientific computing centers are all expected to have a major impact on education and technology transfer. Increases are also being proposed for the NSF's graduate fellowship program for scientific equipment acquisition and for undergraduate and pre-college science and math education.

As we look to the future and ask ourselves what we should be doing now that will support our science and technology enterprise in the next century, the term "multidisciplinary" comes to mind. Much of what we do crosses the lines of traditional university disciplines. The basic science and technology centers proposed for 1988 would respond to the need for university-based interdisciplinary research and technology centers directed to problems of broad national priorities underlying our industrial economy.

In addition to the other science and technology centers, there will be a $10 million plant science initiative sponsored by the Department of Agriculture, the Department of Energy, and the National Science Foundation. This initiative will focus on the application of modern techniques in cellular and molecular biology to agriculture, and it will involve the establishment of multidisciplinary basic research and education centers at academic institutions. One of the great strengths of our research system today is that we get double mileage on it; we do it at our academic institutions, so we promote not only research but we promote training and education as well.

As with the engineering research centers and the basic science and technology centers, the plant science centers will also look to industrial, other private sector, and State and local government participation to provide a major share of their support.

Increases in the Department of Energy's budget for general science will allow greater utilization of the Department's basic research facilities for both academic and Government researchers. There will also be emphasis on greater collaboration between the Department of Energy and industry in fossil, solar, and other energy conservation research and development. These cooperative projects will promote the transfer of technology to the private sector by increasing the number of private sector participants and the degree of their involvement.

It's always been a major tenet of this administration's science and technology policy that the Federal Government should not try to usurp the private sector's role. The greatest strength of this country lies in the ingenuity, skill, and drive of it's private citizens. As we saw last month when the President made awards to the

around-the-world-aircraft Voyager's designer as well as its pilots, private sector initiative and creativity are still very much alive in this country. It's a strong indication of the importance and success of our Federally-funded basic research efforts that Burt Rutan could draw upon the NASA-developed basic technology in materials and aerodynamics and in propulsion for the Voyager aircraft. I believe that the Voyager serves as a model for what can be done when Government-developed basic technology is harnessed by private citizens and by U.S. industry that have the vision of the future and the inner resources to make that vision into a reality.

Now I'd like to address space science and technology for a moment. As we are so keenly aware, one year ago today America lost the dedicated crew of the space shuttle Challenger and the Challenger itself. Since at the time of that tragedy I had just become the Acting Administrator of the National Aeronautics and Space Administration, the sadness for me has a strongly personal dimension. In the dark days that followed that tragedy, relatives of the seven brave companions expressed their hope that our efforts to expand the frontiers of space would not end. They and all of us can take heart in knowing that the President has directed us to ensure that the U.S. space program will continue, and he has increased the NASA baseline research and development budget from $4.2 billion in fiscal 1987 to $4.5 billion in fiscal 1988. The overall NASA budget also reflects a substantial increase for fiscal '88.

This overall NASA increase is necessary primarily to continue development of the space station and to provide for two new initiatives, the Global Geospace Science Program and the Civil Space Technology Initiative. GGS will expand international cooperative efforts to investigate the interaction of the sun with the earth's environment, and CSTI will explore a range of enabling space technologies important to continued U.S. leadership in space, and of course other parts of the overall funding will be to return us to space flight as soon as it's safe to do so. For other science and applications programs, the budget continues support for major flight projects, including the space telescope, the Galileo mission to Jupiter, the upper atmosphere research satellite, and the ocean topography mission.

The setbacks that the United States has had with the Delta booster, the Titan, and the shuttle space launchers has made it clear that our national launch capability had become too narrow and vulnerable to error. To rectify this situation, NASA will soon begin replacing the Challenger, and the Department of Defense is taking several important steps regarding expendable launch vehicles.

First, the DOD is increasing its acquisition of Titan IV's, which will have approximately the same cargo capacity as the shuttle.

Second, the DOD is developing a medium expendable launch vehicle to deliver intermediate sized payloads to orbit. The acquisition plan for the medium expendable makes specific provision for its use as a private commercial launch vehicle as well as a Government launcher.

Finally, the DOD has asked for $250 million in its 1987 supplemental budget request and a further $300 million in the 1988 budget to initiate work on a heavy launch vehicle which will have

a 100,000 pound class payload capacity. The resources required to develop, construct, and operate these launchers necessitate that they be viewed as national launch assets and that they be acquired and employed in a manner that reflects the best use of these capabilities to meet our national launch requirements and priorities.

That concludes my prepared statement, Mr. Chairman, and I will be happy to respond to your questions.

[The prepared statement of Dr. Graham follows:]

STATEMENT OF DR. WILLIAM R. GRAHAM
SCIENCE ADVISOR TO THE PRESIDENT
AND DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
BEFORE THE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

WASHINGTON, D.C.
JANUARY 28, 1987

Mr. Chairman and Members of the Committee:

Introduction

Having appeared before you several times in other capacities, it is a privilege to be here today, as the Director of the Office of Science and Technology Policy. I have a short statement to begin with, after which I'll be glad to answer questions.

The President's proposed budget for Fiscal Year 1988 continues to emphasize maintaining national security, strengthening our economic competitiveness in the international marketplace, improving the quality of life for all Americans, and continuing to pursue the themes of our intellectual and cultural heritages. Obviously, science and technology can contribute to the realization of all these goals.

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Improvement of U.S. economic competitiveness in the world is a major theme of this budget. The Administration recognizes that our future position in global markets will depend to a great extent upon:

- the continuing development of the foundation of our science and technology in basic research;
- the allocation of our national resources on a long-term and reliable basis to generate new knowledge;
- the effective and timely transfer of new knowledge from our laboratories and universities to our industry, economy, and national security.

To this end, specific increases in basic research have been proposed by the President. These include a 17 percent increase in the basic research funding for the National Science Foundation, from $1.36 billion in fiscal 1987 to $1.59 billion in fiscal 1988.

Life Sciences

In the area of life sciences, the Department of Health and Human Services (HHS) R&D activities in 1988 will continue to be funded at stable and sustainable levels. In 1988, the National Institutes of Health will support about 19,100 research project grants, about 560 research centers, and about 10,900 research trainees. In addition, the budget proposes funding for the full, multiyear costs of grant commitments incurred in 1988. This would eliminate annual uncertainties over the level and timing of allotments for grantees and insure proper review of the full cost of funding additional grants. In 1988, the total HHS obligations will approach $6.3 billion, approximately the same level as fiscal year 1987, while outlays will increase by about $200 million in fiscal 1988.

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Science, Technology, and Global Competitiveness

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Increased investment in basic research and in transferring that research to industry will strengthen and modernize our educational capabilities and help train our next generation while it is advancing our knowledge and improving our ability to put that knowledge to work. In particular, NSF's engineering research centers, new basic science and technology centers, and advanced scientific computing centers are all expected to have a major impact on education and technology transfer. Increases are also being proposed for NSF's graduate fellowship program, for scientific equipment, and for undergraduate and precollege science and math education.

As we look to the future and ask ourselves what we should be doing now that will support our science and technology enterprise in the next century, the term "multidisciplinary" comes to mind. Much of what we must do crosses the lines of traditional university disciplines. The basic science and technology centers proposed for 1988 would respond to the need for university-based interdisciplinary research and technology centers directed to problems of broad natonal priorities underlying our industrial economy.

In addition to the other science and technology centers, there will be a $10 million plant science initiative sponsored by the Department of Agriculture, the Department of Energy, and the NSF. This initiative will focus on the application of modern techniques in cellular and molecular biology to agriculture, and it will involve the establishment of multidisciplinary basic research and education centers at academic institutions. As with the engineering research centers and the basic science and technology centers, the plant science centers will also look to industrial, other private sector, and state and local government participation to provide a major share of their support.

Increases in the Department of Energy's budget for general science will allow greater utilization of the Department's basic research facilities for both academic and government researchers. There will also be emphasis on greater collaboration between the Department and industry in fossil, solar, and other energy conservation research and development. These cooperative projects will promote the transfer of technology to the private sector by increasing the number of private sector participants and the degree of their involvement.

It has always been a major tenet of this Administration's science and technology policy that the Federal government should not try to usurp the private sector's role. The greatest strength of this country lies in the ingenuity, skill and drive of its private citizens. As we saw last month, when the President made awards to the around-the-world-aircraft Voyager's designer as well as to its pilots, private sector initiative and creativity are very much alive in this country. It is a strong indication of the importance and success of our Federally funded basic research efforts that Burt Rutan could draw on NASA-developed basic technology in materials, aerodynamics, and propulsion for the Voyager. I believe that the Voyager serves as a model of what can be done when government-developed basic technology is harnessed by private citizens and U.S. industry that have a vision of the future and the inner resources to make that vision into a reality.

Space Science and Technology

As we are all so keenly aware, one year ago today America lost the dedicated crew of the Space Shuttle Challenger and the Challenger itself. Since at the time of the tragedy I had just become the Acting Administrator of the National Aeronautics and Space Administration, the sadness has for me a strongly personal dimension. In the dark days following that tragedy, relatives of the seven brave companions expressed their hope that our efforts to expand the frontiers of space would not end. They and all of us can take heart in knowing that the President has directed us to ensure that the U.S. space program will continue, and he has increased the NASA baseline research and development budget from $4.2 billion in fiscal 1987 to $4.5 billion in fiscal 1988.

This increase is necessary primarily to continue development of the Space Station and to provide for two new initiatives, Global Geospace Science Program (GGS) and the Civil Space Technology Initiative (CSTI). GGS will expand international cooperative efforts to investigate the interaction of the Sun with the Earth's environment, and CSTI will explore a range of enabling space technologies important to continued U.S. leadership in space. For other science and applications programs, the budget continues support for major flight projects, including the Space Telescope, the Galileo mission to Jupiter, the Upper Atmosphere Research Satellite, and the Ocean Topography Mission (TOPEX).

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Second, the DOD is developing a medium expendable launch vehicle (MELV) to deliver intermediate sized payloads to orbit. The acquisition plan for the MELV makes specific provision for its use as a private commercial launch vehicle, as well as a government launcher.

Finally, the DOD has asked for $250 million in its 1987 supplemental budget request and a further $300 million in the 1988 budget to initiate work on a heavy launch vehicle, which will have a hundred thousand pound class payload capacity. The resources required to develop, construct, and operate these launchers necessitate that they be viewed as national launch assets, and that they be acquired and employed in a manner that reflects the best use of their capabilities to meet our national launch requirements and priorities.

This concludes my prepared statement, Mr. Chairman. I would be happy to respond to your questions.

Mr. ROE. I thank the gentleman for his statement, and before we go to questions, without objection, television broadcast, radio broadcast, still photography, and other means of coverage will be permitted during the full committee hearing today.

The Chair defers to our distinguished ranking Republican Member, Mr. Lujan from New Mexico.

Mr. LUJAN. Thank you very much, Mr. Chairman, and, Dr. Graham, having gone over the entire budget for R&D, I think it's a good budget; it bodes well for the Nation's efforts in research and development; and, besides that, last night's State of the Union by the President, his emphasis on R&D and on competitiveness, I think we look forward to a good year with that kind of a budget and that kind of emphasis from the administration, and we thank you for that.

But I've always felt that all research that we do should somehow end up in being of some use to Dr. Graham, the individual, and Manuel Lujan as an individual, that we would get some benefits from it. Certainly defense and all of those things are very good, but in the final analysis how does it benefit the average citizen in their everyday life? That's why this committee has been very interested in the entire commercialization process, because that's how we're going to get it out to the general public.

I don't find any hesitation on anybody's part to bringing in and encouraging the private sector in research, the kinds of research that we will do in the space station, for example; all of those things are encouraged; but I do find a big reluctance within NASA to allow the private sector into the launching business. I think that perhaps we need a very strong policy determination on the part of the administration, and to articulate it very strongly so that there is no question in anyone's mind that that is the policy of the United States, to give the opportunity to private launchers. Can you give me your thoughts and feelings and whether we ought to go in that direction?

Dr. GRAHAM. Yes, sir. Both as a matter of circumstance and as a matter of policy, the launch of commercial satellites will have to be done largely outside of the specific hardware that's acquired by the Government, and that includes the space shuttle, and that includes expendables that are acquired as serial items by the Government.

Our launch capacity just for Government payloads, for scientific payloads, for national security payloads, is being tested to its limits to deliver the weight to orbit and the systems to orbit that we need, and in fact, as I'm sure NASA has and will testify, even using all of the resources that we can reasonably prepare, there will still be shortfalls over previous projections of requirements. That's the necessity. The policy has now been put forward very clearly by the President through specific National Security Decision directives and by his own statements indicating that we are to encourage and work with the private sector, but the private sector launch service industry is going to have to provide the launch capability for commercial satellites in the future. We would very much like that to be a U.S. launch service industry, and we want to make sure that that industry has every opportunity to grow and prosper.

Mr. LUJAN. Would that include as part of your policy recommendation that we aid that industry to start up and grow, including relaxing antitrust rules that might hamper it? Perhaps some kind of a subsidy? I don't mean shoveling the money to them but letting them use the facilities at no cost or being as helpful as we can. I guess we all fear that if we just drop it like that, then of course foreign launchers would be in a prime position to pick it up. So are you willing to make that policy recommendation that we aid them in the relaxation of antitrust regulations and maybe some subsidy in terms of services provided?

Dr. GRAHAM. I think in the entire area of regulation we should be very careful not to interfere with the private sector's ability to provide launch services. I don't think that the launch service industry is in any danger of becoming a private monopoly or that an unfair restraint of trade is likely to take place in that area in the foreseeable future. So I think we should look very hard at any regulatory restrictions that may occur and try to help, as the Government, clear those out of the way of the private sector, and, by the way, that applies not only to launch services but to all of our industry and particularly our high technology industry that has to compete with very, very competent foreign technology and foreign companies.

In addition to that, of course, the Government does much of the system development work and can provide developed systems which have already absorbed the nonrecurring cost of particular launch vehicles, and that's a major asset to commercial launch industries. By the way, that's similar to what foreign competition does with the development of their launchers at Government expense before they turn it over to private or semi-private organizations to operate.

Finally, we can make launch facilities available to the private sector on a non-interference basis with national and Governmental launch operations, and I think there is a substantial capacity there, and provide it for the private sector on a direct cost basis. In other words, the out-of-pocket cost to the Government for providing these facilities should be borne by the private sector, but all of the other costs that go into the facilities, such as the construction costs and so on, shouldn't be borne by the private sector because the Government would build the facilities in any case, and that again also reflects foreign practice in this area.

So I think there are many things the Government can do and should do to encourage this. I would not support a direct subsidy of the industry, because I think that tends to encourage inefficiency in the industry, and we'd like this to be an efficient, internationally competitive launch service industry.

Mr. LUJAN. Yes.

One final thing. I guess we're all concerned now that the February '88 launch—and we look at it from both standpoints, I guess. One, I would hate to see it postponed. Then, on the other hand, well, if we're not ready, if there're things to be done, we'd better not launch in '88. What do you see? Do you see us launching Discovery in February of '88, or do you see that stretched out a little more?

Dr. GRAHAM. I have not been tracking the schedule of that on a day-to-day basis. NASA certainly understands its instructions to launch as soon as it's safe to do so and not a day before. The people there—Admiral Truly and the other people in the space flight operations—are keenly aware of all of the issues and working very diligently on them, and I'll defer to NASA's judgment as to when they are prepared to launch. I do note, however, that the National Academies have three groups also providing cross-check and oversight on the NASA activities, and those have proven to be very helpful as well. So I think we've got a process in place that's going to get us to a safe launch as soon as we can, and I'm not going to speculate on when that date's going to be, because it depends on things that have yet to happen.

Mr. LUJAN. Thank you, Mr. Chairman. I have some other questions, but I'll come back on the second round later on.

Mr. ROE. I thank the gentleman from New Mexico. We'll try to keep now to the five-minute rule as close as possible so that as many Members can have the chance to ask Dr. Graham additional questions.

The Chair recognizes the distinguished majority Member from California, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

Dr. Graham, starting with the last part of your statement first, you refer to the development of the medium expendable launch vehicle and then to the request for funds to initiate the heavy launch vehicle. We also have in process the national aerospaceplane, which is a manned heavy-lift vehicle, I guess you would say.

Do you feel that there has been overall adequate consideration in the planning for the diverse uses of this fleet of vehicles ,that we're going to have need for all of these, or are they going to be to some degree redundant if we were to have this whole fleet in operation?

Dr. GRAHAM. Mr. Brown, planning for launch vehicles is a dynamic process, and it will continue to be so. However, I think we now understand that our base of launch was too narrow in the past and it must be broadened, and several steps must be taken to do that. Our launch capability starts today down at the few hundred pound range, with the all-solid Scout System, and goes up to the shuttle capacity. The medium expandable launch vehicle fills an important niche at the few thousand pound level, which will prove useful to both commercial and to governmental requirements.

But if we look at all the capacity that we envision for the shuttle, including the replacement for the Challenger, and our production capability projections for the Titans, we still see additional requirements in the outyears, but in a time which is before the time that we hope to be able to have the aerospaceplane as an operational vehicle, which would be some time around the end of the century, 13 years. So I believe that each of these vehicles, including the heavy launch vehicle, which would have at the outset two to three times the launch capability, the lift capability, payload of the shuttle, and would have the capability to evolve into an even larger launch vehicle, are all strongly called for and justified.

Mr. BROWN. The driving force for the medium launch vehicle is the need by the Defense Department to place in orbit the global positioning system satellites; is that right?

Dr. GRAHAM. That's the immediate Defense Department application.

Mr. BROWN. The heavy launch vehicle would be driven primarily by what need?

Dr. GRAHAM. It's been put forward as a part of the Strategic Defense Initiative budget and would be done as a preparatory step to space defense initiative deployment, or at least prototype work.

Mr. BROWN. In the event, however, that the Congress were to do as it has in the previous generation and decide to curtail the deployment of the SDI, there would be no need for the heavy launch vehicle in the immediate future then, would there?

Dr. GRAHAM. One of the needs would go away if that were to take place, and I certainly hope it doesn't take place, Mr. Brown. But should we further retard the development of the Strategic Defense Initiative, there would still be, in my view, a substantial need for a heavy launch vehicle to carry both the backlog that's building up now and to be able to supplement the launch capability of the future which will be less than the figure we were planning before the Challenger accident.

Mr. BROWN. Well, we can deal with that in more detail later. Let me ask you one other question, if I may.

You make reference to the importance of the new civil space technology initiative in NASA, and I concur with that. I think it's a valuable initiative. I have difficulty, however, in reconciling it with the administration's continuing refusal to request funds for the advanced communication technology satellite, which is, as far as I can tell, the most important immediate space technology initiative that would meet American needs.

Dr. GRAHAM. This gets to the distinction between the developmental activities that have a specific industrial commercial application and the underlying technologies we need to support a broad reach of our economy and specific Government requirements. The civil space technology initiative is designed to give us a broader technological base for our space launch and space transportation capability once in orbit. Of course, the advanced communication technology satellite is to provide a prototype for a specific commercial communications satellite.

The administration and I believe that that protyping of a specific commercial item is better left to the forces of the economy and industrial judgment.

Mr. BROWN. I'd like to have you at some future time, not now, elaborate on that distinction a little bit more. This Committee and the Congress have not agreed with the logic behind that in the past. I don't think they will this year. But I think you ought to be permitted to lay out the justification in a little greater detail at an appropriate time.

Dr. GRAHAM. Yes, sir.

Mr. ROE. The Chair recognizes the distinguished gentleman from Pennsylvania, Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman.

First of all, welcome, Dr. Graham. We appreciate your coming today.

Dr. GRAHAM. Thank you.

Mr. WALKER. I guess initially I'm going to do something I don't like to do, and that is put a question in the form of a statement. But I want you to react to the statement. And that is, whether or not you share my concern that the country at the moment lacks a defined space policy, that we have tended now to have our space initiatives defined in terms of projects rather than policy; that when we talk about the national aerospaceplane, heavy launch lift vehicle, medium launch vehicles, whatever it is, that we tend to project on the idea of each of these projects, space station as a project, that I fail to see how it fits into an overall national space strategy. And whether or not you don't share a concern that I have, that we are doing a lot of things in space—SDI, space station, various kinds of launch vehicles—all without any idea of where we are going after all of those things are in place.

Would you comment on that? Would you tell us whether or not the administration has some intention of coming forth with a plan that would fit all of those into a context? I think that there's a way that SDI, space station, heavy launch vehicles, all of those things, fit into a general framework, but that framework hasn't been defined.

Dr. GRAHAM. Mr. Walker, I believe that we may have been remiss in spelling those out as clearly as we might have in the past. However, there is a general framework here, and one which is specific enough to give us guidance to proceed and yet general enough to be accommodating of technical advancements, changes, opportunities, that we see in the future. We can't do ten and fifteen year plans on breakthroughs, but we can certainly have the general thrust of our efforts well defined.

Mr. WALKER. Well, let me ask you a question: When SDI is being defined, is SDI being defined with the idea that some of the elements of it could be used for commercial activities as well? In other words, when we build power stations for SDI, are we thinking about the fact that they might have commercial applications for use as auxilliary space—or power systems for the space station? Is that kind of infrastructure—As we are expending resources, is that kind of infrastructure decision being made within the administration?

Dr. GRAHAM. Yes, sir. The spinoffs of the military and the basic research programs are of great interest and being worked——

Mr. WALKER. Not spinoffs, not spinoffs. I'm interested in whether or not we are defining, as a part of an overall space plan, things that we do, where we expend resources, whether or not they have applications beyond the immediate thing that we're doing.

I have some frustration, that as we build a space station—first of all, we heard from the military that they had no use for the space station. Then all of a sudden, as we are trying to get international partners in on it, all of a sudden the military wants to have veto power over the space station. Now, it seems to me that is all because it lacks definition of what it is we're trying to achieve. We can't maintain the development of resources for a space program and do that.

Where is the coordinated policy?

Dr. GRAHAM. Well, I think you make a good point, that we need to be careful that these things do play together. In space power, for

example, one of the major sources of power that we're looking to in the future for planetary missions and also for some missions locally is nuclear power. And the nuclear power program that's being conducted now, space nuclear power, is being done on a very coordinated effort between the Department of Energy, which has interest both in commercial and in military applications of energy, and NASA, whose focus is primarily scientific and civil, and the Department of Defense, whose focus is primarily military. They are——

Mr. ROE. Will the gentleman yield?

Dr. GRAHAM [continuing]. Working together on the power—space power program.

Mr. ROE. Will the gentleman from Pennsylvania yield?

Mr. WALKER. I would be glad to yield to the gentleman, as long as I don't run out of time here.

Mr. ROE. Oh, no. We'll give you extra time.

I think the gentleman is making, in this particular area, a very, very important point, which this Chairman intends to pursue with the greatest of diligence and vigor. It seems to me that if we have a disparate situation between R&D in the DOD budget and the NASA and the whole bit, we ought to know where we're going. It seems to me the gentleman makes a splendid point with the point of view that the interrelationship between the orbiter and the space station and what's going to happen to SDI vis-a-vis the need of that shuttle, is all one and the same. And I, for one, applaud his questioning and hope that the administration starts to look at that, because I can rather firmly suggest to the distinguished witness that this committee is going to. In the absence of a decision being made, this committee is going to set that policy.

I thank the gentleman for yielding.

Mr. WALKER. I thank the gentleman.

You see, my concern is, as the gentleman from California raises the question of the heavy lift launch vehicle. What is the application of that beyond SDI? There may be some. But the problem is that if you talk about putting communication satellites in it, in order to make it pay you'd have to put five or six of them in it. That's fine, except who's going to insure that vehicle? There's no coordination between what we are attempting to do on that front and what needs to be done in terms of a development of overall resources in space, and I just don't see that coming from the administration.

I'm afraid that we are ending up doing like we did with Apollo, coming up with a great success, where we went to the moon, and then had nothing to follow on. We developed a space shuttle to go to a space station but didn't develop the space station. And now we're developing a space station with no idea of what the infrastructure is that should surround it.

You know, all of those things can be brought into perspective, it seems to me, but we need some sense of leadership to do it. I'm just afraid I don't see that happening.

What I'd like to hear from you is, when are we going to see that happening?

Dr. GRAHAM. I think it's incumbent upon us to articulate the overall space policy better than it has been. In the specific issue of

the heavy launcher, one of the earliest promoters of that idea was a consortium of Hughes Aircraft, a part of General Motors, and the Boeing Company, and another consortium with United Technologies. The Hughes one was particularly interesting because they looked to a heavy launch capability to ensure that they can get their commercial communications satellites to orbit. So they are the ones who are taking the risk and they are the ones who are putting forward the money and selling the satellites, and they're enthusiastic about a heavy lift capability and willing to provide a measure of support for that.

Mr. WALKER. Just one comment. It seems to me, if you look at that overall question, then there becomes nothing more important to the future of our space program than a crash program to develop a national aerospaceplane; that if you look at the whole infrastructure question and you look at a total policy, having low-cost delivery to space that is represented by the national aerospaceplane becomes absolutely essential to the point of needing a crash program to develop that.

But we are going to have trouble getting the resources developed to have that crash program so long as there's no definition as to what that vehicle is going to be able to do. It's going to be able to do marvelous things, but it won't happen without definition.

Thank you, Mr. Chairman.

Dr. GRAHAM. No question that's a key issue and, in fact, a constraint and a goal not only of the aerospaceplane but of the medium expendable launch vehicle and the heavy expendable launch vehicle, trying to get the cost down by—a weight to orbit—by at least an order of magnitude in the foreseeable future.

Mr. ROE. The Chair recognizes the distinguished gentlelady from Tennessee, Mrs. Lloyd.

Mrs. LLOYD. Thank you very much, Mr. Chairman.

Dr. Graham, I also would like to welcome you as our first witness to the committee this year.

I also am very heartened that the administration is placing a greater emphasis on our economic competitiveness in technology transfer. Like my colleague, Mr. Lujan, I think in many respects it should be a very good year, but I must tell you that I see about a $500 million shortfall in energy R&D programs. I hope we can reach a better compromise on that.

My colleague, Mr. Walker, referred to a lack of focus on our space program. I'm hoping in this Congress—and I've discussed this with our Chairman; we share the feeling—that the time has come that this committee come up with a national energy policy.

I came to this committee 12 years ago after the Arab oil embargo. It was the goal then, under the leadership of Mike McCormack—and we worked to get to the area at the time—that we could have a national energy policy. The Carter administration didn't provide this lead, and after six years we haven't seen it with this administration.

Now, I certainly hope the Department would work with us this year in formulating a national energy policy, a program that looks at what each of our technologies can contribute to our mix, our energy mix, and also to look at what our real needs are going to be at the turn of the century. Certainly our economic stability, our na-

tional security, depends on obtaining this goal. I'm also very interested in technology transfer. I'm really concerned as to whether or not the Department of Energy is really moving fast enough in implementing our patent policy.

Are you really content with the way the Department is processing our patent waivers for our civilian R&D work?

Dr. GRAHAM. We are embarking on that issue with renewed impetus from the President, and the Technology Transfer Act of '86 influences that, the global competitiveness influences that, and the general desire to get regulatory barriers out of the way influences that.

I think you'll see an acceleration in that area this year. I certainly intend to encourage that strongly.

Mrs. LLOYD. But I think it has—In all fairness, it has been a long time coming. And as you know, we included some language in the DOE/DOD bill last year to try to accelerate our technology transfer, our patent waivers. I'm just very concerned that we aren't moving our class waivers. I'm considering putting in some language in our bill this year to sort of speed these along. But there must be more than rhetoric. We are going to have to move on with our class waivers if we are going to do anything about moving our technology to the civilian marketplace.

I'm concerned about the fact that the administration has zeroed our request for the AVLIS program. As you know, we have abandoned the centrifuge program, and I'm really concerned that the private sector is not going to take up the AVLIS program. They're not going to move ahead this technology. They don't have the money and it certainly doesn't make economic sense to put your money into technology if there's no return in 10 or 15 years.

Now, last year this committee met with the members of the Japanese Diet in discussing our energy research and development programs. There is a great deal of dismay in the Pacific Basin over the fact that we really were abandoning our enrichment research and development programs, that they didn't view us as a reliable partner, as their supplier of enriched uranium.

Could you comment on your feelings in this area?

Dr. GRAHAM. Mrs. Lloyd, I believe this is an area primarily driven by the economics and by the budget deficit issue. The enrichment budget is still a very substantial budget; there's substantial commitments to TVA and others for use of power and production in this. And the view was that trying to sustain the AVLIS program, the laser separation program, on top of all the other expenditures in this area——

Mrs. LLOYD. This is the only R&D program we have at the present time.

Dr. GRAHAM. However, we also have a separation production capacity, and the view was that the balance of the expenditure required to continue AVLIS versus the requirement for enriched fuel, within the scope of what we could do with our existing capability, didn't warrant continuing the R&D at this time. However, we do propose to terminate it in such a fashion that it can be picked up at a future time and continued when the requirement is greater and the enrichment costs are less.

Mrs. LLOYD. Thank you, Mr. Chairman.

Mr. ROE. I thank the gentlelady.

The Chair recognizes the distinguished gentleman from Florida, Mr. Nelson.

Mr. NELSON. Dr. Graham, sadly I note that 22 minutes from now a year ago a lot of people here had a very bad day. And I think it's important, it's symbolic, that on this particular day that we remember, that we also look ahead and that we start to focus not just looking back, but looking to the future and rebuilding. So my question to you, first of all, is to compliment you, that out of all the machinations of OMB that you did get the civilian space budget up to nine-and-a-half billion. My compliments to you and Dr. Fletcher and others that worked directly on the politics of the administration in the allocation of the dollars.

My question to you is predicated with a statement that in the rebuilding of this nation's space program, as we try to move to greatness and achieving excellence, nine-and-a-half billion in fiscal year '88 isn't going to cut it. For within your allocation, even getting it up to nine-and-a-half billion, you've dropped out ACTS, which is the Advanced Communications Technology Satellite, of which you don't want to do that, but OMB has forced you to do that. They did it last year and they're doing it again now in fiscal year '88. And that's about a 75 million dollar item. And if the indication of this committee of its past intent is anything, then it's likely to pursue ACTS as an important technology for this country.

You are dropping out *LANDSAT*. Here the French have the *SPOT* satellite up. This is a remote sensing technology that has given this country all kinds of advantages. Certainly you know the advantages to the Department of Defense. And here again, for the second year in a row, the administration is proposing dropping that out. You're trying to slip the Mars Observer from 1990 to '92, when, in fact, it's very clear that the Soviets intend very much, in a big way, to go to Mars. And if the possibility of cooperation is there with the Soviets in the future, then we're just putting us that much more behind, ourselves behind the power curve by trying to slip from '90 to '92. And then other sensing satellites, such as the NROSS or the Naval Remote Ocean Sensing Satellite, that's dropped out of the budget, too.

Now, on top of that, you know, we've got four great planetary missions. And in this budget you're only providing for the launching of three of them. We may as well face the fact that that fourth one we're probably not going to launch it on the shuttle. Let's go out and buy a Titan IV so we can get that well on its way to its destination in this solar system.

So, having predicated my question, I would like you just then to comment about what is the reality of the Reagan budget vis-a-vis the civilian space program.

Dr. GRAHAM. As you mentioned at the start, Mr. Nelson, it is up substantially from the '87 budget, and in addition, the '88 budget does not bear any of the cost of the replacement for the Challenger, which was put entirely in the '87 budget. So we have it on a reasonable baseline with the pre-Challenger budget, which before the accident was at the 7.6 billion dollar level. So it's a very substantial increase.

I think we have to look at our ability to absorb increases as we go forward here and make good use of the funds that we have appropriated.

Mr. ROE. Will the gentleman yield?

Mr. NELSON. Indeed.

Mr. ROE. Would you explain to the committee the cost of sustaining the space telescope? I mean, this runs into millions of dollars a month, as I understand. Would you give a little elucidation on that?

Mr. NELSON. Yes, sir. The fact is we've got this incredible piece of technology that we had hoped would be up there and functioning, and the fact that we're at least down for two years and can't launch—and it, of course, will be one of the priorities when we start launching the shuttle again. But, in the meantime, you just can't stick it in a warehouse, as Chairman Roe points out, and let it sit. You've got to keep its systems up and running. It's got to be constantly nourished. It's got to be constantly attended to by some of the best scientific minds. And so the cost is a rather extraordinary cost. It's six million dollars per what, a year—a month, just to attend it.

Mr. ROE. If the gentleman would yield further, has the administration given any consideration of not only putting the—we're talking about money driving everything around here. Is the administration giving any consideration—We speak to the areas of high tech and how important it is in the President's speech last night. But here's an element that's critically important to the dynamics of the whole program and the country, and we're spending six million dollars a month to let it sit there.

Does anybody coordinate the costs and suggest along the line when we set priorities that that ought to be taken into consideration?

Dr. GRAHAM. I have some personal experience with that particular priority———

Mr. ROE. I know you do. That's why I asked the question.

Dr. GRAHAM. I can assure you that no one wants to get the Hubble Space Telescope to orbit and usefully engaged faster than the administration and NASA. That satellite requires the Tracking and Data Relay Satellite, the TDRS satellite, to be fully effective because it has to relay the data through TDRS and down to the ground station. So if you look at the launch schedule, there is one or two very high priority national security launches. The TDRS launch and the very first space launch that goes up is the Hubble Space Telescope. And there was some discussion of the specific order of those when we were preparing the manifest, and it was worked out in logical sequence. You can't use the telescope until you get TDRS up, so put it up first, and then take care of these most critical and urgent national security satellites and give only those priority over the Hubble Space Telescope.

What you're seeing here in the space telescope area, and I believe in the fourth planetary and in the Mars observer, is a reflection of the fact that we're deficient on our launch capability today. The slip for the Mars observer from '90 to '92, the last time I looked at it, which was several months ago, was a result of the fact that other payloads came in before that with priority.

As far as the Titan IV for the fourth planetary is concerned, I would have to go back and look at that carefully. However, I'm concerned that our ability to produce Titan IVs is running close to its limit in that time frame. So I'm not certain that we can generate that much additional launch capability, whatever the funding of the situation.

There is no question we're in a difficult situation with launch capability. This committee recognized that last year, NASA recognized it, the administration recognized it, and we look forward to working together to continue to do something about it.

Mr. NELSON. Mr. Chairman, I don't wish to indulge the committee any further, but there is a specific answer to each one of the responses that Dr. Graham—and he's being a good soldier and he's doing what he has to do, and I understand that.

For example, if you couldn't get a Titan IV in time, you can look at the performance that you can get out of a Titan III, and there may well be a Titan III, which used to be called the III-4-D, available for one of those planetary missions. So there is a response. The question is, what is the will of this nation.

Now, I can tell you what the will of the people of this nation is, and that is, they want nothing less than an excellent space program. Now, the question is, are we going to enact what is the top agenda, one of the top agenda items of the American people.

Thank you, Mr. Chairman.

Mr. ROE. I thank the distinguished gentleman.

The distinguished gentleman from Illinois, Mr. Fawell.

Mr. FAWELL. Thank you, Mr. Chairman.

My questions would be in general, along the lines of the amount of funds which are being spent for civilian-oriented R&D as opposed to the military-oriented R&D. Several months ago I was surprised to realize that, I think, in about 1980 the amount of civilian-oriented R&D funds was about 15 billion and the military-oriented R&D about a like amount. And yet, the latest figures that I was able to secure were that that has now—the difference is now lengthened quite a bit, roughly about 16 billion for civilian R&D and something like 42 billion for military-related R&D. I see from the figures you have set forth here where we would have 64.8 billion for the conduct of research and development. It appears to me that we're talking about 18.2 civilian, so 46.6 military-related R&D.

Keeping in mind that the civilian-oriented R&D is certainly an important basis for our economic future, and recognizing that our main competitors commercially in the world—Japan, West Germany, et cetera—are putting a great deal more percentages of GNP into civilian-oriented R&D, what comments would you have here? I certainly appreciate the movement ahead—we're apparently moving at least somewhat ahead in civilian-oriented R&D—but the military is so usurping the area, and with less spinoff than ever before from what I hear, I can't help but be deeply concerned about this. Could you comment on that?

Dr. GRAHAM. Yes. The category R&D causes some definitional problems here which color the funding allocation. I think if you note that the development accounts—not the research, but the development of specific hardware items, tends to dominate the defense and military costs; whereas in the civilian areas we're dis-

cussing—the dominant theme is in research—you'll find a balance that's more reflective of our actual investment in research.

The military uses quite a number of end items, products, which are unique to the military and, therefore, they have to bear not only the cost of some of the basic research that goes into it, but also the cost of the hardware development, test, design, the very, very large expenditure end of the entire technology spectrum.

In the civilian area, we think it's appropriate that those costs be borne by industry, when it's an industrial product, a commercial item that's being produced. So I think numbers that give the research balance are in this sense more indicative than the research-plus-development figures. And in research we're talking about a total of over nine billion dollars, of which just about 10 percent is for defense and military functions specifically, and the rest is in the civilian area.

Miss SCHNEIDER. Would my colleague yield on that point, please?

Mr. FAWELL. Yes, I would be more than happy to.

Miss SCHNEIDER. I'm afraid, Dr. Graham, that I find your response to my colleague's comments a matter of shifting ground, to put it politely. When we look at the—we're talking about defense R&D versus civilian, and at the same time we're talking about enhancing the U.S. competitiveness capability. If you're looking at the exports currently and the export trend, that the policy that you are articulating and that my colleague is questioning, only a fraction of our high technology exports are in the area of civilian R&D; whereas overwhelmingly now we are finding that we are going to be—we are the number one exporter of military goods in terms of R&D, and that is being reflected in some other numbers which you did not respond with, and those are that of our investment in R&D in industrial competitivenss, for example, is minuscule. It's one percent, compared with the Japanese 18 percent, the Germans 14, and the French 13 percent investment in industrial competitivenss, industrial R&D.

So I think that what concerns me is that you are painting a picture for our science commitment that truly is reflective of where we're putting our money where our mouth is, where our defense dollars are going. And I think that probably every member of this committee is questioning that.

Dr. GRAHAM. I'd like to provide some numbers for the record, if I might. You've raised a larger issue—in fact, several. One is our role in exporting military systems and our investment to that specific end. We tend to develop military systems for our own use and not primarily as an export product.

In terms of our commercial activities, one of the things we're trying to do—and the tax laws now have helped support—is to encourage industry to invest in the developmental costs of products. And if you want to look at a reasonable comparison between us and other countries, I think it's fair, without shifting ground, to look at the total expenditures in the research and development cost in the commercial sector, including Government work, primarily basic research, plus industrial work, primarily specific applied research and developmental work. And I think those compare reasonably well with foreign investments, and I think our problems, while they span a broad range of areas, are much the results of our own

ability to be competitive, to understand the manufacturing technologies, the production engineering and the other fields that other countries have really taken to heart.

I find very seldom a new technology in the commercial area that wasn't invented in the U.S. But, by golly, the foreign countries take those things and they apply them and develop them and productize them in very capable ways. It's tough competition out there that our industries have got to face.

Mr. ROE. Will the gentleman yield? I know you have been generous with your time and I'll give you a couple more minutes.

But I think you're striking at a very important point, and I don't believe, at least from the research we've been able to do, I don't believe there's been any coordinated evaluation between—call it domestic R&D or civilian R&D and the military. I mean, when all is said and done, that has never been investigated. There's nobody we've been able to find out that has that seat of knowledge.

The gentleman, Mr. Fawell.

Mr. FAWELL. There is so much to be said in this area. I would welcome a written response, Dr. Graham, setting forth your views. I don't think we have the time.

One other question I did want to bring up. When we're talking about pure basic research, all of us are still wondering what decision has been made, if any—and when it might be made if it has not been made—in regard to the Superconducting Super Collider, basic research project, which has been peer-reviewed to death and studied. We have the technology. I think all of the science community believes that this is something we should move ahead on.

I realize the tremendous problem of money is certainly crippling everyone, but can you give us some indication, hopefully, that, indeed, in this country, in high-energy physics, basic research is ready to move on this?

Dr. GRAHAM. Yes, the Superconducting Super Collider has certainly been carefully studied, designed and peer-reviewed, and is at this point at the presidential level for decision. It's up to the President when he decides to come to a view on that project and how he wishes to proceed. But it's where the buck stops.

Mr. FAWELL. Thank you.

Mr. ROE. The Chair recognizes the distinguished gentleman from Colorado, Mr. Hefley. Is he here?

The next person is not here. Is Mr. Price from North Carolina here? Is Mr. Price from North Carolina here? Mr. Hayes of Lousiana?

The distinguished gentleman from Texas, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman.

I would like to ask you, Dr. Graham—and before I ask you the question, I'm sure that the President's speech last night was required listening for someone in your capacity, or at least you have read the speech.

Dr. GRAHAM. Yes, sir.

(Laughter.)

Mr. HALL. The President alluded to the promotion of international trade, and he said "we will work to expand our opportunities in international markets through the Uruguay round of trade negotiations and to complete an historic free trade arrangement between

the world's two largest trading partners, Canada and the United States."

And before I inquire as to what he really meant by that, I might point out to you that there is a proposed subcommittee here on Science and Tech dealing with international scientific research cooperation. And I think either Chairman Roe and minority ranking Member Lujan and Dr. Hanson and others were either furnishing the President a speechwriter or they were at least on a par with their thinking of the need for such.

But I think we need to find some avenues of cooperative scientific exchange, and I don't find that you allude to that anywhere in your presentation here, other than you talk about the Global Geospace Science program, expanding international cooperative efforts in certain areas involving, I think, as you pointed out here, interaction of the sun with Earth's environment.

Really, what did the President mean when—and he went on to say "the Congress will soon receive my comprehensive proposals to enhance our competitiveness, including new science and technology centers and strong new funding for basic research." I think too long we have found a reason not to share information, because when we share information internationally we receive information.

I'll give you one example that's been pointed out to me on medical technology. The CAT Scan involved a certain mechanism that was fine to share with other nations of the world and other scientists and other scientific minds and trust, but it invaded some problem about the bomb scope or igniting operations for the MX, and for that reason we withheld it. It seems we are always finding a reason not to deal and cooperate scientifically—internationally.

Do the—Is the information in the program that the President is to send over here to deal with that, or do you know what he's talking about?

Dr. GRAHAM. Yes, sir. There are a number of issues that you brought up. There's a larger issue of our trade with other countries which, as he said, should be free trade, but should also be fair trade. That is to say, we should have the access to foreign markets that they have to our markets. We should have the protection under their laws, patents, intellectual property rights and so on, that they have under ours, that we shouldn't be fighting—competing with government-subsidized industries whose only purpose is to restrict competition. That's in the general trade area, and I think you'll see many initiatives to produce those effects in the near future.

In the science and technology area in particular, we look forward to an environment in the basic sciences which is free and open. We also look forward to an environment where other countries devote a reasonable fraction of their economic power to the basic sciences, so that we're not alone in the world, nor even the only substantial source in the world of scientific progress. We would like to see other countries progress, and we would like to work with them and we would like to draw benefit from their basic research just as they do from our basic research. And we are working with a number of countries in that area. In fact, our major scientific programs tend to be international in nature.

Certainly, if we pursue the Superconducting Super Collider, we will look to the other countries of the western alliance and eventually of the world who would like to use that facility to help in bearing the cost of constructing it. Many of our major space programs—most of them, in fact—are international in nature. We have over a thousand—in fact, we have 1,500 foreign researchers now in the laboratories of the National Institutes of Health and so on. If you go down the list, you will find that just as science itself is an international enterprise, the science conducted by the U.S. Government is very international in its nature. But it must have a basis of fair exchange, reciprocal benefit, as well as just benefit from the work the U.S. does.

Mr. HALL. And the new programs that the President is sending over probably cranks that into the computers. I'd be glad to talk with you some more on that when we don't take the committee's time.

Thank you, Doctor.

Mr. ROE. I thank the gentleman from Texas.

The Chair recognizes the distinguished gentlelady from Rhode Island, Miss Schneider.

Miss SCHNEIDER. It seems that—I'm attempting to strike a new cord. I could elaborate a little bit further on some of the comments that my colleague, Mr. Fawell, mentioned. But many of my colleagues are asking about spending in a number of different disciplines. I am interested in elaborating further on our competitiveness capability, and in order to be competitive, it is essential that we reduce our deficit.

How do you think that is being reflected in the budget proposals that you're suggesting?

Dr. GRAHAM. Well, there are certainly strong linkages between the deficit and our competitiveness. For example, the——

Miss SCHNEIDER. That's my point, that we cannot be competitive unless we reduce our national debt.

Dr. GRAHAM. Exactly, and we couldn't agree more. And to reduce our national debt, the first thing we have to do is reduce and to finally stop increasing our national debt. Of course, that means get the budgetary deficit down. And this budget certainly reflects a major effort to get the deficit down.

Miss SCHNEIDER. How so?

Mr. ROE. Will the gentlelady yield?

Miss SCHNEIDER. Yes, I would be happy to.

Mr. ROE. Well, that's where we're coming from. I mean, I don't know how we can be talking about productivity and how we're going to take driving forces of the economy, which we're out front, which I know the members are boiling over here and want to talk about—we don't have enough time, and I thank you for indulging me. And we're coming back and saying, "Well, we want to keep the deficit down, we want to keep the deficit down" and the whole bit. I don't think it's keeping the deficit down as much as it is where the priorities are going to lie in the country. And, it seems to me that if everybody now begins to recognize science and technology as the cutting edge of the future and for tomorrow, then we ought to be putting that into focus.

The gentlelady from Rhode Island.

Miss SCHNEIDER. Well, I agree completely, and I think that that is essentially what we need to hear. Because as I look at the priorities being established here, they are obviously focusing once again on defense, and over the past six years we have doubled our defense budget overall.

Now, what I would like to point out is that—I'm just curious. As we look at the other disciplines, we have jurisdiction over the Department of Energy, over NIH and others, in terms of their research budget.

Are you aware which is the greatest expenditure—what area of expenditure that the American consumer spends the most on? Just out of curiosity, if we are trying to save our Government money, save the consumer money.

Dr. GRAHAM. No, I'm not, Mrs. Lloyd. If I had to guess, I would say it's——

Miss SCHNEIDER. The name is Schneider.

Dr. GRAHAM. I'm sorry, Mrs. Schneider. Excuse me.

Miss SCHNEIDER. It's all right. All Congresswomen do not look alike.

(Laughter.)

It's Congressmen that all look alike.

(Laughter.)

Dr. GRAHAM. I stand corrected.

Mr. ROE. On that last point, the committee will adjourn.

(Laughter.)

Miss SCHNEIDER. Well, I think it's important for us to acknowledge that the American consumer spends annually 400 billion dollars a year on energy, and yet, if we are setting priorities in our energy budget, then clearly we are not at all looking at how our country can be competitive.

If you look at our investments in R&D in high tech, for example, we have lost seven out of the ten export markets in the last five years. Our potential for saving 150 billion dollars a year lies in the area of energy efficiency. And yet, before this committee, we have seen the Japanese come forward and other nations come forward and we have seen motors, we have seen light bulbs, we have seen all sorts of energy efficiency improvements being lost to foreign markets.

So my point is that if on the one—Out of half of our mouth we're saying "we want to reduce the deficit"; on the other half of our mouth we're saying "well, we want to set priorities, and one of our high priorities is also to compete in the world markets by using our high tech or science and research capabilities." Then what we're saying and what we're doing are two different things, and that distresses me severely.

As you read between the lines and you look at the numbers, and you look at the big picture, we are just not putting our money where our mouth is. And I think, unfortunately, that is being reflected in, you know, your definition of what those priorities are.

Dr. GRAHAM. In the area of energy efficiency, though, it seems to me that the benefit has to come to the consumer and he has to make judgments based upon the cost of these things. Sometimes it is possible to lower the energy consumption of an item, but the cost of the item goes up considerably. There has to be a trade-off that

makes economic sense, and I believe the marketplace is better at making those trade-offs than is the Government.

Miss SCHNEIDER. Well, let me just point out that last year, or two years ago now, I was successful in getting——

Mr. ROE. Would you indulge me for a minute?

Miss SCHNEIDER. Yes.

Mr. ROE. But the citizen doesn't have the right to choose their energy supply. You live in a district and pay whatever the particular price is. If you're paying in New Jersey and Pennsylvania and those areas, you are paying for the cost of the Three Mile Island accident, they just add it on as a surcharge. We didn't have anything to say about it. So I think that when we come back to—if the gentlelady will yield further—then we come back and say, "well, the marketplace will determine that", but the citizen doesn't have anything to say about that. They can go and protest to the public utilities commission, but whatever happens in that area they're going to have to pay for. That's not an equitable situation.

The gentlelady is——

Miss SCHNEIDER. And to continue further along that line, our Government expenditures are setting the guidelines as to how we will manipulate the energy markets, because as we provide subsidies, whether it be in R&D or in tax credits or whatever, it is very clear that we are not giving consumers that choice. But we are saying, "Here, this is what the Government is going to subsidize and you must have this type of energy." I think that if we're going to say, "well, we have a free market with energy", then let's have it.

I have been badgering the Department of Energy to implement an electronic bulletin board, a clearinghouse of information. And you talk about technology transfer, on how we can transfer what technology we have here in this country just out to the different States insofar as energy efficiency equipment, and it has been like pulling teeth.

Now, if there is truly a scientific commitment in this administration, I would think that this would be the kind of thing that would facilitate progress, facilitate reducing this 400 billion a year that the American public pays in, you know, through our taxes or whatever. And I don't see that kind of leadership, nor understanding of the problem.

Dr. GRAHAM. It's certainly the intention, across the board, in the economy to lower the deficit, to try to work on the overall national debt, and to do it in an environment which maintains our security, not only in a military sense but in an energy security sense as well. And we'll certainly be hearing more about energy security in the weeks to come, I'm sure from you and also from the administration.

Nevertheless, to the greatest extent possible, the administration is strongly in favor of having market forces exercised in the use of energies in terms of the light bulbs, in terms of the energy efficient technologies, and even, where possible, in terms of the large-scale national grids which provide the generation of energy.

Mr. ROE. Well, before we call on the distinguished gentleman from North Carolina, I think it's fair for me to say at this time that this committee is going to look very, very seriously at the

energy issue, vis-a-vis the point of view that we're going to combine the energy subcommittees that have heretofore been in this committee. I do hope that when we call for an overview of the energy issues, as Mrs. Lloyd is preparing to do, that the administration would alert itself to what they're going to do if the price of oil goes from 19 dollars a barrel to 28 dollars a barrel, or 25 dollars a barrel. I happen to think that that's an extremely important issue, that we're just sitting on a time bomb waiting for the energy issue to erupt all over again. So I just wanted to add that as a codicil to the distinguished lady's questioning from Rhode Island.

The Chair recognizes the distinguished gentleman from North Carolina, Mr. Valentine.

Mr. VALENTINE. Thank you, Mr. Chairman.

Dr. Graham, on page 3 of your prepared statement, you make a reference to proposed increases in NSF's graduate fellowship program. Now, that's all well and good. Of course, I suppose almost anybody could come to Congress and make a good argument for the proposition that whatever it is that they're interested in should be the leading national priority.

But doesn't the President's budget recommendation also include a suggestion that Congress reduce the funding for the student loan program in this country, or at least not improve on that? Are you familiar with the budget, that phase of it—as I know you are. My colleague, Mr. Hall, has prepared—laid a foundation for that, kind of.

Dr. GRAHAM. Yes, sir. That refers to the part of the budget that goes across the board on student support in science and technology and in other areas. And the intention there is to first try to put incentives to halt the rapidly increasing cost of university education which has been going up much faster than the cost of living over the last decade. And second, to try to reflect the cost of college education to a greater extent upon the person who derives the greatest benefit from it, which is the student himself, but in a way which allows everyone to get an education and not limit a person's ability to be educated because of his financial resources as a student and what that means as a student loan program.

Those two principles—those three, actually—making college education within the reach of everyone who can qualify for it, in trying to put disincentives to further increasing the cost of college education, and finally, let each individual bear a greater part of the cost of his education, because he certainly bears a great part of the benefit—in the case of the average student, it's worth about 600,000 dollars over his life time with a college education——

Mr. VALENTINE. I understand that. That's all well and good, and we're talking about—at least I don't intend to be talking about grants. I'm talking about loans. But doesn't this administration advocate a reduction in the funding for student loan programs, at the same time that we say we need to improve our situation in education?

Mr. ROE. Will the gentleman suspend? We will now take up 73 seconds of silence.

(Whereupon, at 11:38 a.m., the Committee observed 73 seconds of silence.)

Mr. ROE. The gentleman from North Carolina.

Dr. GRAHAM. Mr. Valentine, the current loan program is designed to—is somewhat of a misnomer. It is a heavily subsidized loan in which interest rates of subsidies are provided by the Government. The intention is to move away from that, to decrease the subsidized loans, and at the same time to bring up a pool, which will eventually be a revolving fund, to help students obtain loans by basically using themselves as their collateral for the loan. That's the intention of the legislation at this point.

Mr. VALENTINE. Let me ask you one more question, Doctor. We hear a lot of talk here and elsewhere, and we see on television, and we read about this erosion of American technology and knowhow. And you alluded to a phase of it a while ago, our overseas competitors who take the initiatives which came from this country and improve on those projects and propositions.

Do we have in any organized fashion, an apparatus in the Federal Government that kind of looks at that from the other point of view? You know, after World War II, I thought—I think we liberated a young prodigy by the name of Dr. Von Braun, and almost all of the Peenemünde apparatus.

Do we have any way to make an orderly monitoring of what they do now—in West Germany, for example, in Japan—so as to try to kind of turn the tables on that situation?

Dr. GRAHAM. Our industry is certainly sensitive to that issue and growing in its reputation in these countries for just that purpose. We are also looking to strengthen our scientific attaches and our scientific representation in our embassies in the advanced countries. And, of course, our commercial attaches and other representatives of the U.S. Government overseas attempt to track this.

But it's my view that at this point in time we are not as good at that as other countries are. Perhaps they have more to gain by watching us than we have to gain by watching them, but I believe we need to increase our interest in that. I think there's a major private sector responsibility in that area, but government should be helpful wherever it can.

Mr. VALENTINE. Thank you, sir.

Thank you, Mr. Chairman.

Mr. ROE. The Chair recognizes the distinguished gentleman from Pennsylvania, Mr. Ritter.

Mr. RITTER. Thank you, Mr. Chairman.

Welcome, Dr. Graham. It's a pleasure to have you here and we look forward to a fruitful relationship between your office, yourself, and this committee, of course, in the upcoming term.

Dr. GRAHAM. Thank you.

Mr. RITTER. We, of course, have a distinguished contingent of Nobel Prize winners. We lead the world on a per capita basis—actually, England surpasses the United States—and basic science is not exactly the problem that the United States is facing in a highly competitive global economy. You need the basic science to underpin the technology. But in terms of commercialization of innovation, in terms of bringing basic science to technology and to products, let's face it; we are suffering with respect to far shorter commercialization time than the Japanese have. In some of these newly industrializing countries, the "new Japans", the fact is that we are preeminent in science, but there is an electronic revolution

that's already gone through the world and instantaneous information transfer is the order of the day. So this basic science can be transferred around the world readily.

What about the problem that we have in commercializing this innovation, and do you foresee a Federal role to help to stimulate this activity of technology advancement into the commercial marketplace? Because that's really where we're lagging. We're not lagging in the production of scientific information.

Dr. GRAHAM. Well, science is a rapidly moving field, and I think we dare not rest in our basic research capabilities because, while we may be very good at it today, if we slow down very long we'll find ourselves behind the pack on it.

But, having said that, there is——

Mr. RITTER. I didn't advocate slowing down, but what I'm saying is where the real problem is lying is not in the science arena.

Dr. GRAHAM. Yes. If we can maintain our momentum in the basic research, then we nevertheless have to address the serious problem in deriving economic benefit from that basic research, the commercialization of it and the application to our agriculture and so on.

Before the turn of the century, we learned how to prosper by taking the basic research that was done primarily in Europe and industrializing it here even more quickly than the Europeans could in some areas. Other countries have now learned that trick from us and we've got to remember how we did it.

Mr. RITTER. What do you see as the policies of encouragement of coming out of the—for example, the President's Commission on Industrial Competitiveness, that should be a linchpin of policy orientation. Is it?

Dr. GRAHAM. Yes, that and several other things that have happened in about the same time frame. We are very concerned with that specific issue, and if you look at the President's legislative statement that went along with the State of the Union, you will find him addressing your specific concern in that.

Several steps have been taken, and more will be taken, to deal with it. But the main message I want to give you is that's a very large blip on our radar screen.

Mr. RITTER. Yeah. I read some of the, Dr. Graham, some of the accompanying details, and I think it's definitely a step in the right direction. But I would urge you to give that kind of focus because that's where the gap is. And we could expand the basic research horizons to the point where we are the information synch for the entire world and yet continue to have the same problems in the speed at which innovation is commercialized.

For example, the impact of regulation on American technological advancement is significant. We—you know, if you talk about barriers to the world market—my switch is on, but it's—we've got a problem in this country in putting hazards in perspective. You can go through a litany of—thanks. You can go through a litany of industries where the United States should be number one in the world, and maybe isn't any more and is losing ground.

You could—you know, there's a lot of pro and con on all different sides. But let's face it. We've lost pre-eminence in the nuclear industry. Yet that was an American—invented here—an industry

where we had a 10- or 15-year lead on the rest of the world. We've lost—right now, in a very interesting position in biotechnology. People are dealing in this country commercially with the diagnostic end, but the therapeutic end, which has to go through a stiff regulatory battle, may be lost to foreign competition.

Some of the companies are exporting these kinds of research projects to foreign countries. For example, anything that involves release into the environment is almost hazardous to produce here because of potential regulatory hurdles. Chemicals and that kind of industry, where we have always shown a great export surplus, we're on the verge of potentially exporting a good deal of that, where it involves the regulatory side of things.

I'm concerned that this administration has or doesn't have the focus on this concept of putting—helping society, this country, our people, put hazards into a realistic focus so that we look at some of these things not too differently from the way the Japanese, the Germans and the French and newly industrialized country competitors do in the Far East.

Could he potentially answer that, Mr. Chairman?

Mr. ROE. Dr. Graham.

Dr. GRAHAM. There is no question that our ability to apply our basic research is a major issue and strongly perceived both by you and certainly by the administration. We live in a world which is a risky place, and we are going to have to continually address not the fact that there is some risk associated with our activities, but the risk in comparison with the benefit that we derive from them. I don't know any other way to proceed in this world because it's not a zero risk world.

Mr. RITTER. Might I add, the risk in comparison with risks that we're willing to take 24 hours a day—I'm not trying to minimize the exposure to risk, but I think we lack a mechanism to put them in some rational rank order, some rational perspective, so as to deal with modern technology in a way that doesn't put us at a disadvantage with competitors who are appropriately dealing with those.

Dr. GRAHAM. I certainly agree with——

Mr. RITTER. Do you have a policy, do you have a program, do you have a focus in an area such as this?

Dr. GRAHAM. Yes, very much. This is an issue which is large on the overall global competitiveness scale, and, in fact, the Vice President is now heading a Commission on Regulatory Reform which is looking at our regulatory environment across the board to see where we can, in fact, improve it, to get government out of the way of industry and at the same time maintain a balance of the risk and the benefit to our citizens.

Mr. RITTER. One closing comment, Mr. Chairman. The idea of a competitiveness impact statement, if not the bureaucracy of it, the concept of it, is something that could be valuable as we find out we're dealing with a lot of competitors other than ourselves. Thank you.

Mr. ROE. The Chair recognizes the distinguished gentleman from Pennsylvania, Mr. Walgren.

Mr. WALGREN. Thank you, Mr. Chairman.

I can't help but, in thinking of the 73 seconds, remembering the magnitude of that loss, and thinking too, that in many ways we, in these interchanges, are trying to prevent similar losses. If you look back on the Challenger history and remember that memorandum in—I think it was July of the year before the Challenger was lost—and there was a fellow in the rocket division that wrote a memo trying to get attention to the problem of the seal and the danger that the failure of the seal would cause, and he wrote a memo which essentially started with the word "help". He couldn't get the attention of the bureaucracy that was administering the review of the problem of the seals. And even warned them they were in danger of the maximum accident, losing the launch pad, the vehicle, and the crew. And yet, somehow or other, that word was not heard.

I think a lot of the members here feel that we want the word about civilian research and development heard in our society. And the President himself, in the State of the Union address, emphasized the importance of the development of American scientific and technology capability. And to me, the question really is whether we're going to do something significant about it.

The danger that we all have in government is we have a marginal program, a program that just sort of adds a little bit around the edges. We cut ribbons on high-rises for the elderly, and yet there's a five-year waiting list for people to get in it. Now, is that a significant program for those that are in the fifth year of a waiting list to get into a high-rise for the elderly? It's not a significant program; it is just a gesture at the margin. And the danger is that we will have gestures at the margin in this area as well.

I wanted to ask whether or not you feel that we will mount a significant science education program in response to the challenge that we now feel internationally. In that view, look back and look at the last significant effort we made in science education, probably in response to the Sputnik program, or the Sputnik challenge, where in 1962 or thereabouts we were spending what would be 250 million dollars through the National Science Foundation a year for science and engineering education. We are now feeling good that an increase that will bring us up to 115 million or thereabouts is being proposed.

Now, in view of the fact that we were at 250, and we are trying to increase our effort to 115, is that a significant and responsive program?

Dr. GRAHAM. Americans hate to be beat at things, and we're being beaten by the foreign students in our science, our math, education. And I think that message is coming home. People are beginning to understand it here—certainly in the administration, here in Congress, and I believe in the public at large.

We are almost doubling the funds for work in science and mathematics education through the National Science Foundation for fiscal year 1988. That's just the tip of the iceberg. That work is designed to pull in the elements which provide the financial basis for our educational system for those 15,000 school districts out there, which is——

Mr. WALGREN. Let me stop you there, if I could, because when we're almost doubling the number that is something in the range

of 60 million dollars, and doubling it from a base that was essentially wiped out by the direction that the administration took in 1980. The first thing they did when they came in and took office—the science engineering education expenditure was about 70 million dollars at that time—they zeroed it out. They eliminated the directorate, and we wound up with about four people at the National Science Foundation concerned in this area.

Now, we can't take much solace in doubling effort when you're starting from such a zero base. And as I say, I think the reference point ought to be where we were, let's say, in 1962. We were at 250 million dollars in 1962, if you restated those dollars for inflation—and that may be an underestimate because it's just a rule of the thumb. Do you think that that's—shouldn't we be doing what we did in response to the Sputnik crisis, given the importance of science and engineering education for the American future?

Dr. GRAHAM. We should certainly be doing more both at the national level and at the state and school district level. And the school district level is where the real leverage is. We're trying to increase the national support for this at a rate which can be responsibly spent as we go forward. And as you know, organizations don't tend to be efficient when they're given very large discontinuities.

Mr. ROE. Will the gentleman yield?

Mr. WALGREN. I would be happy to yield.

Mr. ROE. You know what's boiling my blood? Have you got any kids?

Dr. GRAHAM. Yes, sir.

Mr. ROE. They can take those Atari toys, they can take those computers, and they know more about taking a computer apart than most of the scientists do. And I asked some of the leaders—we've been meeting in different groups in Fair Play, and the leaders in education—and I said to them, "Tell me something; why can't we direct the curriculum to the third grade? Why don't we use the tools of the 21st Century? That's what we've designed and built." I'm not talking about 70 million dollars. It's directing the nation on a national basis. Seventy million dollars is a drop in the bucket that we're talking about.

Do you know the response I got? The response I got from very great leaders in this country in the field of academics and education was "Well, that's the mores of the tribe. It'll take generations to do that." In the mean time, the damned country is going to hell in a handbasket and the kids can't get a chance to learn. Why are they leaving education in grammar school and early high school? They're leaving because they're bored to death with the garbage they're getting taught in the schools today.

And I mean to be very strong—you'll have more time. I mean to be very strong on this committee when we start talking about the truth of where we're going to invest in the future of this nation, and it comes with the kids, and you've got to start them in the third grade. You have the Japanese sending all their people over here to learn at MIT, and other countries sending people over, and we can't even take care of our own. And the future of America lies with those kids, and it lies in the third grade, not in the academia, in the third and fourth year in college.

You'll pardon my enthusiasm, but I just had to respond to the gentleman's query from Pennsylvania on that issue.

Dr. GRAHAM. Let me just second that, Mr. Roe.

Mr. ROE. Good.

Dr. GRAHAM. Everything you just said I strongly agree with. We are trying to take some steps in that direction. It's not all a Federal Government issue. The Federal Government has a major role to play, but the learned societies, the academies, the teachers themselves, the school districts, we've got to bring all of those together.

There is something now that's been going about a year called the National Science Education Board, which is drawing together civic leaders, teachers, teachers college administrators and professors, and researchers from our university system, and trying to put together representative curricula from the kindergarten right on through the undergraduate education. We lose so many people because of the poor way that we teach mathematics today, and the poor way that we teach science, that even those students at the first grade start about a third of them wanting to be scientists or engineers, by the time we get to the undergraduate level it's something like four percent of the population who are interested in it. We've got to stop discouraging those people and start encouraging them, and that's very much on the agenda.

Mr. ROE. My good father taught me a point—how does it go—"tempus fugit, momento mori", time flies, remember death. How long do we have to study it? God, we know the answer now.

Mr. WALGREN. If I might——

Mr. ROE. The gentleman from Pennsylvania.

Mr. WALGREN [continuing]. Say as a young person, I have been very impressed with the wisdom——

Mr. ROE. "Younger."

(Laughter.)

Mr. WALGREN [continuing]. With the wisdom of the people that went before me, and in this particular area I think we all ought to ask ourselves whether there really is anything new under the sun. And, with that, the point to me is that we know how to help the educational structure. We did it before. The people in 1960 were not that dumb. What happened in 1980 was people came in and said, "Oh, the old programs are no good so we'll zero them out." What happens four years later? We wiped out the graduate fellowships and now we're adding them back in.

There really is relatively nothing new under the sun, except for perhaps some new techniques and things like that, which would be applied with the same human mechanisms that were used in 1960. So my point is that while we sit back and congratulate ourselves on recommending increases, we ought to realize the level of effort that we're talking about, ask ourselves whether it truly will make a difference, or whether it is just a very marginal response that will leave the nation at a loss.

Dr. GRAHAM. I believe there are two new things. One is that we understand today that not only does our scientific, our math, our technological education affect our national security; it affects the basis on which that national security is built, which is our underlying economy. And in many areas of the economy we are being beaten by foreign competition—not all, we're still very good in

some; we certainly are the leaders in the world of high tech activities such as commercial aviation. But in many we're getting beaten, and people understand that. And they understand that we've got to get better at our education to overcome that, and second, today we understand that this is not a crisis problem; this is a chronic problem. This is a problem we're going to have to deal with year after year and decade after decade, because that's the only way to survive in a very competitive world that we find ourselves and, in fact, that we helped to create.

Mr. WALGREN. If I could just note one long-term trend, when we say we recognize we must improve the educational aspect of it. In 1960 or thereabouts science education occupied about 60 percent of the National Science Foundation effort. It now occupies six percent of the National Science Foundation effort. As the Science Advisor to the Present, certainly—and us as well, in our own responsibilities—we ought to be asking ourselves whether six percent of that kind of effort is the proper range, given the importance of that area to the national future.

Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman from Pennsylvania.

Remember, the greatest asset that America has is its human assets. All the rest of it is peripheral.

The gentleman from California, the distinguished Mr. Mineta.

Mr. MINETA. Thank you very much, Mr. Chairman. Dr. Graham, it's good to have you here.

Your predecessor, Dr. Keyworth, had a great interest about our Federal laboratories, and we had a very distinguished person from our area of Santa Clara County, David Packard, who then had an in-depth study under his chairmanship about those Federal laboratories. I'm wondering if you have had an opportunity to take a look at that study and where you're coming from relative to those laboratories, the missions, and whether or not our Federal commitment to those laboratories really is sufficient. We seem to be building in terms of capital infrastructure, and yet I see from our local paper that the budget crunch is going to cripple the Stanford Linear Accelerator Center, that they're going to have to mothball two of their machines, one which helped to earn a Nobel Prize. I just see this not only as it impacts on Stanford, but Berkeley and the Tevatron at Fermi Lab and all these other centers.

I'm wondering what you're doing to try and come up with a remedial program, or whether you've done anything to even take a look at the Keyworth/Packard report.

Dr. GRAHAM. In the specific case of the Stanford Linear Accelerator, that facility, as you know, has just finished a major upgrade into a colliding beam facility, and that particular new capability is what's being exercised in the future. It's a characteristic of these high-energy research tools that they become obsolete as time goes on, and some of them we shut down before we would like to because there are still things that we can get out of them, but we're always moving to the frontier and pushing in that direction. That's certainly happening at SLAC, it's happening at the Tevatron at Brookhaven.

As far as the national labs across the board are concerned, we're trying very hard in the '88 budget, and this year, in fact, to form a

better link between our economic base, our private industry, and the laboratories. This has to be done in a somewhat balanced fashion because we don't want to undermine the reason the taxpayer is supporting the laboratories, its primary missions. At the same time, we'd like to derive all the benefit we can from the laboratory and make sure its products and its research products are available to our economic welfare as rapidly as possible. So it's a balancing that's taking place. But things like the Technology Transfer Act, the plan to allow licensing of patents that are generated inside the laboratories and related activities are certainly being strongly encouraged, both by the Congress and by the administration.

Mr. MINETA. Do those efforts really—are those mostly in the defense area rather than civilian-related basic research?

Dr. GRAHAM. They will apply across the board. Some of the major national laboratories are defense-related laboratories, some of the Department of Energy labs and some of the Department of Defense laboratories. But the intention to make sure that the laboratories can contribute as much as possible to our basic research and to our economy is an across-the-board attempt and applies well beyond the defense laboratories, although it includes them.

Mr. MINETA. But aren't the civil labs being more and more—getting work that's dedicated to DOD type research, and especially SDI research?

Dr. GRAHAM. Well, SDI is about on the order of ten percent of the Department of Defense research budget, and so it's certainly a source of research funding and it looks for the best places in the country to get that research done. And some of the best places are the Government laboratories, and some are the universities and some are industry. Of course, each of the industries and, of course, to some extent, the Government laboratories, have some discretion in what work they take on as well. But we want to see both our national security provided for, in a way that's as sound and as efficient as possible, and often that means bringing in the best, and that means the Government laboratories.

Mr. MINETA. Mr. Chairman, if I might, it just bothers me when I see the administration touting that they're increasing the budget for Federal R&D by eight percent, and yet the DOD budget consumes 70 percent of that total R&D funding, and basic research is up only four percent.

The other related part of it is the fact that we—I'm getting more and more concerned about the Department of Defense being identified with the work of NASA, and how we maintain a distinct and separate civilian space program. I see this, I guess intrusion, into a civil space agency more and more by the Department of Defense. And on page 5 of your testimony you end up talking about NASA and space, and yet, you're talking about DOD here. It just really bothers me to see this militarization of the NASA civil space program.

Thank you, Mr. Chairman.

Dr. GRAHAM. In addition to the increase in the National Science Foundation funding for '88, there's also an increase in the physical sciences budget for the Department of Energy, which supports much of the work that you describe.

What I was attempting to say in my statement is that on these major systems—the shuttle, the Titan IV, the heavy launch vehicle, if we proceed with that, and others—these are national capabilities. It's very unlikely that we're going to develop a civilian version and a national security version, and they should be built and used as national capabilities and reflect our national priorities. That was the intention of my comments.

Mr. MINETA. But by the same token, Doctor, the payload manifests on every one of them are more military than they are civil.

Dr. GRAHAM. That reflects the fact of the moment, and that is, we hope, a temporary condition, a fact first that without a sound national security, it's not possible to have a strong economy and a sound civil environment, and second, that we're very, very short on resources to launch as a result of the Challenger accident and the subsequent——

Mr. MINETA. Well, when I look at the number of payload manifests that are needed, and when I look at space station, I see that all getting a military twist to every one of those programs, and that's what bothers me intensely.

Mr. ROE. The Chair recognizes the distinguished gentleman from Missouri, Mr. Volkmer.

Mr. VOLKMER. Thank you very much, Mr. Chairman.

Dr. Graham, I would like to change the subject to something that interests me a little bit, an area that has been of some concern to me for the last couple years, and that is in the area of genetic engineering biotechnology products.

On June 26th, 1986, OSTP published a coordinated framework for regulation of biotechnology. This framework reflected the work of the Biotechnology Science Coordinating Committee, which coordinated the regulatory policies of various agencies.

Most, if not all, of the BSCC's work was conducted in closed meetings. What does OSTP as a supervisory body of the BSCC intend to do to open up BSCC's deliberations on regulatory policy to public scrutiny?

Dr. GRAHAM. As you know, much of that happened before I joined OSTP.

Mr. VOLKMER. I realize that.

Dr. GRAHAM. But——

Mr. VOLKMER. But there are things ongoing right now?

Dr. GRAHAM. Yes, sir.

Mr. VOLKMER. Some of us have been waiting now for over six months for a definition of what a release into the environment is.

Dr. GRAHAM. Yes, sir.

Mr. VOLKMER. And so is industry and everybody else that is involved in this, and yet there's been nothing done.

Dr. GRAHAM. As I——

Mr. VOLKMER. And when that's developed, why can't the public have an input into it, or at least know what's going on?

Dr. GRAHAM. As I recall the process, particularly in the last year, it's involved in increasing input from the public and increasing opportunities to do that, including hearings—

Mr. VOLKMER. Since June.

Dr. GRAHAM. I'm not——

Mr. VOLKMER. It started in July.

Dr. GRAHAM. I will have to ask one of my colleagues. The Assistant Directors of OSTP are seated here behind me and perhaps they can help me on this.

But there have been meetings to date, and certainly there'll be several more meetings as we go forward in the regulatory process. There have also been specific occasions where inputs from the public and from any sector have been solicited and have been accepted, reviewed, reviewed in open meetings as well as closed meetings, and used to effect the regulatory structure of biotechnology.

The intention is certainly to involve the public and whoever wishes to be a part of this in the process, and we are moving more and more toward that.

Mr. VOLKMER. Dr. Graham, it's been my observation that in two years of looking at this, a little over two years now, starting in December, actually, of '84—that one of the problems right now is that public acceptance of a genetically engineered product, especially if it's a microbial, or bacteriological type of product, has been genetically-engineered, that could or could not be carcinogenic or highly toxic. And, as a result, we've seen what's happening in my district in Missouri, and the State of California, where public bodies and the public themself have stopped any release.

Now, I'm saying is, it's not just government overregulation that can cause problems, without public acceptance of a product you're not going to be able to do it, in my opinion. And industry isn't going to be able to do it. And we could lose something that most of us say holds great promise for this country. And one other area that needs to be addressed very seriously now that hasn't really been addressed at all by the government, and that is, how do we do risk assessment when we do not have any research going on in order to develop a data base?

What plans does OSTP have to promote risk assessment so that the regulatory policy can be based on firm data and experience?

Dr. GRAHAM. I may not be familiar with all the activities under way in the country but I know a few of them in this area. NSF has a general program in the area of risk and risk benefit analysis. In the specific biological areas, the regulatory structure that's been proved to date leaves the specifics of that to the specific product that's being proposed and the specific characteristics of that.

There is work under way on the ecology of microbial structures, for example, which will affect how they prosper or die in the open environment, and that will certainly factor into this risk assessment that's under way.

But eventually it will come down to a specific item and a specific regulatory regime for that, and I don't know how to do that in a general sense. We are going to have to do it in a case-by-case basis, at least until we understand it better.

Mr. VOLKMER. It's my understanding right now within even industry within research communities that are developing genetically engineered products for release and for usage that in many instances there has been no risk assessment on those at all, that we haven't even developed a protocol as to how to do positive risk assessment.

And as I understand it, NSF's program on risk assessment in this area is less than a million dollars. What I'm trying to say is,

we're really not—we're paying more attention to getting out here and developing products at any cost, to try and stay ahead of the international community, without realizing that the public out there better be satisfied, that there is not going to be any risk or the public isn't going to stand for it. They saw what happened in the chemical industry and other things. And they're not going to let it happen in genetically-engineered products, especially if you use the word microbial or bacteriological out there, you immediately put up a red sign for anybody out in the public—I guarantee you.

Dr. GRAHAM. Let me ask my colleagues to address the specifics of the risk assessment that's going on. However, if we make our standard one that there can be a zero risk associated with it, then we're very inconsistent in applying that. We certainly wouldn't have driven in to work today if we'd taken a zero risk attitude.

And while I don't want to encourage risk—in fact, we want to minimize it—what we want to do is maximize the benefit that we can obtain within a highly constrained risk. And that has got to be an attitude that we foster in the public and in their understanding of this—something they intuitively understand in most of their activities, virtually all of which have a measure of risk associated with them.

Mr. VOLKMER. Should the public just take it for granted that the industry will take care of it, and you don't have to worry about what the industry's going to do?

Dr. GRAHAM. No, sir. I'm sure we agree that there needs to be more than individual checks on this process. There needs to be a general regulatory regime under which these things are done, and that has been the intention of the Biological Science's Coordinating Committee, and the activities of the government for the last several years in this area, and those will become increasingly open. In fact, the BSCC has made a public commitment to open—to have several open meetings during 1987.

Mr. VOLKMER. Mr. Chairman, could I have one additional minute——

Mr. ROE. Yes, certainly.

Mr. VOLKMER [continuing]. Because the only other thing that I would like to say again, and in all the hearings and studies that I've made on the subject, I find one other area that needs seriously to be addressed, and that is to eliminate the confusion within the regulatory system to the industry as to where to go to have what license or licenses necessary, and what steps have to be taken.

There are those out there that aren't really sure where they have to go.

Dr. GRAHAM. That has been in fact the intention of the regulatory activities to date, to try to coordinate the different departments. Clearly, the Environmental Protection Agency has a role in some activities; the Department of Agriculture; sometimes the National Institutes of Health if it involves a research issue; and so on. So, there——

Mr. VOLKMER. But——

Dr. GRAHAM. What we're trying to do is get a focus for each issue so that you have one primary place to go for that issue.

Mr. VOLKMER. And only one, so that you don't have to go through one and then end up having to go over to the second one also and start the process.

Dr. GRAHAM. That's right.

Mr. VOLKMER. Thank you.

Mr. ROE. The Chair recognizes the gentlelady from Maryland, Mrs. Morella.

Mrs. MORELLA. I think I have it. Thank you, Mr. Chairman.

I will remember you, Dr. Graham, not only because of what you've said and the information that you will get back to this committee, but because this is the first meeting of the committee for me and I'm pleased to serve on Science, Space, and Technology.

My question has to do with the understanding that the Secretary of Defense has requested that all international negotiations space—on space stations—be suspended until DOD receives assurances that they'll be permitted to conduct SDI initiative experiments aboard the station.

After being told for many years that there was no Defense plans for the stations, why has this policy shifted? Also, how are our international partners reacting? What is your role in this policy, and what is your view of this policy?

Dr. GRAHAM. Well, I'm pleased to be here today at your first meeting and I hope I can give you an answer worthy of your question.

There in fact has not been a shift in policy in this matter. The Defense Department has requested that the U.S. Government have time to make sure that it's in general synchronization before we discuss the subject further with our allies—and that seems to me appropriate. We should make sure we've got our own act together before we take it to our allies. That's the intention here.

The DOD has for some years said a very particular statement on the space station. They have said, "We have no requirement for a permanent man's presence in space at this time." And that is still their position on the space station.

At the same time, the space station program has also had a consistent policy, and that is, that the space station would be both a national and an international asset. It's, as you know, an $8 billion-plus program with substantial foreign investment—a very large-scale effort, and one of these national resources that we've been talking about.

There has never been any intention to exclude from the space station national security activities, research and related activities, for example. The legislation associated with the space station, as I recall, has carried the phrase that it is to be used for peaceful purposes, and that is something that the administration is in complete accord with.

However, it is, I would like to emphasize that there is no discrepancy—in fact, there's strong complimentary between using the station for national security support, such as I've described, on the one hand, and peaceful purposes on the other. In fact, the purpose of our establishment to maintain our national security is to maintain a regime of peace for this country, and we hope for our allies and the rest of the world.

And so should there become instances where the space station can profitably be used to help national security, that is certainly not inconsistent with peaceful purposes. In fact, it's strongly supportive of peaceful purposes. And we want to make sure that concept is reflected in the space station agreements as we go forward.

Mrs. MORELLA. So, does that mean that the SDI experiments would be required?

Dr. GRAHAM. I don't know of any SDI requirements to the space station at this point. However, it seems to me appropriate that the possibility of doing national security-related experiments which could include SDI-related experiments on the space station should certainly not be excluded at this time. It should be an option that's determined by the circumstances of the technology as we go forward.

Mrs. MORELLA. And just finally, have you had any reactions from our international allies about this policy?

Dr. GRAHAM. Yes, I talked to senior representatives from one of them last week in fact, and, they, strongly support the concept that the space station is to be used for peaceful purposes, and I believe they understand and in fact greatly benefit from the importance of our own national security and that of our allies to maintain a regime of peace in the world.

So I see no great inconsistencies there.

Mrs. MORELLA. Thank you.

Thank you, Mr. Chairman.

Mr. ROE. The Chair recognizes the distinguished gentleman from Iowa, Mr. Nagle.

Mr. NAGLE. I have no questions, Mr. Chairman.

Mr. ROE. The Chair recognizes the distinguished gentleman from Kentucky, Mr. Perkins. Do you have any questions?

Mr. PERKINS. I have no questions, Mr. Chairman.

Mr. ROE. The Chair recognizes the distinguished gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman, and welcome again to the committee.

Mr. ROE. Thank you.

Mr. PACKARD. The, —mine is just a straight, simple and specific question. I've had an interest in the Superconducting Super Collider, the SSC, and I see where that is not included in the budget, and I just would be interested in the administration and perhaps your specific, attitude, or stat—position on that project.

Dr. GRAHAM. Mr. Packard, we spent several years, as you—as you know, and have followed closely, and in fact encouraged us to prepare for the possibility of going into wholesale development and construction of the Superconducting Super Collider.

I believe at this point the design at the current level is sound and will work—that we have reasonable estimate of the facility, overall, and the schedule under which it can be developed.

We have only a very general idea of the scientific results we'll get from it, but that's what basic research is all about—you don't know what the answer's going to be before you turn it on.

The high energy physics community is convinced virtually to a man that there will be substantial results that will be derived from this machine if in fact it's built. Of course, the other side of the

scale is that the cost of the machine is very large—it's a $4 billion-plus scientific instrument—the biggest basic scientific instrument, both in cost and in size, that would ever have been built, if it in fact it is approved.

The SSC has gone to the President for his review and I expect that he will make a decision on it in the near future.

Mr. PACKARD. And until then, there are several States and of course several groups that are interested in it, and, so there is no—no policy decision made yet by the administration, but you expect some decision as to whether it will be a go or a no-go within the next, what, three—a few months, a few weeks?

Dr. GRAHAM. I don't want to predict the President's schedule on this too carefully, but certainly, within the next few months, and probably sooner than that, as I see his schedule on it now.

Mr. PACKARD. Thank you very much.

Dr. GRAHAM. And after that we'll start—if it's approved, and if we decide to proceed—then there'll be a long series of events that will lead to site selection and so on and so forth.

Mr. PACKARD. I'm aware of that. I'm aware of that. Thank you very much.

Mr. ROE. I thank the gentleman from California.

The gentleman from California?

Mr. BROWN. Mr. Chairman, I'd like Dr. Graham to respond to some questions in writing if the committee has no objection to it.

Mr. ROE. If the gentleman would yield, we have no objection at all, and we—the committee has developed, in addition to Mr. Brown's specific questions, a series of questions that we would like to submit to you for—giving you a chance to review them and to come back and with a written response.

Mr. BROWN. It was those questions I had in mind, Mr. Chairman.

Mr. ROE. Fine.

Dr. GRAHAM. Yes, sir.

Mr. ROE. That's wonderful, all right.

If no objection, so ordered.

The committee has no further questions. We want to thank you very much, you and your colleagues, for joining us as our first witness, and we appreciate the responses that you have given to us.

The committee will now stand adjourned.

[Whereupon, at 12:30 p.m., the committee was adjourned.]

APPENDIX

Additional Questions Submitted by Dr. Graham for the Record

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Line 613

QUESTION: Mr. Brown (D,CA) asks Dr. Graham to elaborate on why prototyping a specific commercial item is better left to the forces of economy and industrial judgment (in reference to a civil space technology initiative)

ANSWER: The Federal government has not demonstrated an exemplary record of commercial development in alternate energy sources, the use of space, in some forms of agriculture, and in many other areas. There are many reasons for the failures but a common objective of Federal R&D has always been missing when it engaged in commercial development: the need to produce a profit at the peril of the institutional existence.

The successes of the Federal Government have always been in the long-range, high-risk areas usually characterized as basic research. The worldwide strength of our Federal laboratory and university researchers is undisputed and the forces that drive short-term commercial development of products and processes in our industry have produced a powerful free economy. Neither sector has shown a general ability to enter well into the realm of the other and we feel that it is far better to make sure the objectives of the two sectors complement each other. Prototyping by the Federal government has been used to show industry the wisdom of commercializing certain products, but the Not-Invented-Here influence has also produced some examples of waste of government funds. We far prefer to have the two sectors working in partnership over the R&D process with government researchers participating primarily in the R phase and the industry researchers participating in the D phase.

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Line 1133

QUESTION: Mr. Fawell (R,IL) asks for a written response comparing proportion of government funding of civilian R&D and military R&D as this affects U.S. competitiveness.

ANSWER: The attached table shows how Federal R&D obligations are distributed across the Federal departments and agencies.

The actual distribution is given for FY 86, and estimate is made for FY 87, and a projected estimate is given for FY 88 assuming the proposed budget delivered on Jan. 5, 1987.

In the FY 88 number, 44.02B is recommended for military R&D and 20.73B is recommended for civilian R&D. The proposed military component includes research, development, test and evaluation of components related primarily to the maintenance of our national defense. The civilian component includes proposed expenditures which in many cases influence economic competitiveness. It is often found that the primary objectives of one sector satisfy secondary objectives included in the other. However, we see no reason to arbitrarily compare the two. We prefer that the Congress consider the primary objective of each area independently and assess the degree to which the recommended budget satisfies each.

CONDUCT OF RESEARCH AND DEVELOPMENT
BY
MAJOR DEPARTMENTS AND AGENCIES

(in millions of dollars)

Department or Agency	Obligations		
	1986 Actual	1987 Estimate	1988 Estimate
Defense-Military functions	34,205	37,533	44,080
Health and Human Services	5,661	6,353	6,294
(National Institutes of Health)	(5,004)	(5,519)	(5,573)
Energy	4,708	4,801	5,016
National Aeronautics and Space Administration	3,420	4,185	4,498
National Science Foundation	1,336	1,441	1,680
Agriculture	925	978	961
Transportation	387	308	290
Interior	378	366	364
Enviormental Protection Agency	317	329	346
Commerce	394	397	333
Agency for International Development	211	217	233
Veterns Admistration	188	211	214
All Other	483	514	463
TOTAL	52,612	57,631	64,771

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Line 2077

QUESTION: "Let me ask my colleagues to address the specifics of the risk assessment that's going on."

ANSWER: All concerned with processes, products, research and regulation involving intentional release are mindful of the need to be able to judge potential environmental risks. The following activities indicate the Administration's involvement:

1. A subcommittee of the NIH Recombinant DNA Advisory Committee (RAC) has reported to the RAC its "points to consider" for intentional environmental release of R-DNA derived organisms. These were published in the Federal Register, Part II, vol.50, No. 60, March 28, 1985.

2. A joint meeting of delegates representing the BSCC, the National Library of Medicine (NLM), and the Commission of the European Communities has been scheduled. The group will consider the feasibility of developing a data bank based on the existing and to-be-published literature of environmental biology pertinent to risk assessment using methods and equipment NLM has developed for on-line biomedical data retrieval.

3. The NSF, USDA, and the Department of Energy jointly have agreed to increase funding for plant science, as indicated in the FY 1988 budget request. They plan to establish university-based centers based on cooperative activities between State and local governments, Federal government and industry. One of the types of centers would be concerned with "Rhizosphere Dynamics and Microbial Ecology." In part, research and training would be dedicated to the natural history and horizontal gene flow of microbial populations in soils, and plant- microbial interactions. Data generated are expected to contribute significant information applicable to risk assessment protocols. OSTP played a leading role in the studies that led to this budgetary initiative.

4. The NSF soon will announce that it will receive proposals for interdisciplinary research on risk

perception, communication, and management. Awards are expected to be in the range of $400,000-500,000 per year for three years.

5. The Biotechnology Science Coordinating Committee, through its Subcommittee on Research, is reviewing agency activities on risk assessment methodology and areas of environmental studies, such as effects, dispersal and mitigation, that are applicable to release of genetically modified organisms. Results will be influential in agency priority setting and budgetary emphases.

ADOPTION OF METRIC SYSTEM

QUESTION: We hear horror stories occasionally about confusion related to measurement systems resulting from the failure of the United States Government to make wider use of the metric system. For instance, we understand that use of the English system of measurement in the SDI program has meant that U.S. researchers have had to spend time translating computations and codes done elsewhere in metric back into feet and pounds. We view favorably some recent procurements from the Pentagon which were in metric. Do you expect any effort on the part of the government to increase the use of metric in its own programs and procurements especially when those programs have international implications or are likely to involve spinoffs that American manufacturers could market worldwide?

ANSWER: The adoption of the metric system has been slow. There have been instances where the adoption of the metric system would have simplied scientific exchange. A most recent example occurred following the Chernobyl Nuclear Accident. At that time numerous problems in measuring radiation exposures occurred between many countries because the adoption of the Standard International Units system (metric) had not been completed. The Department of Commerce is the agency responsible for defining the metric system for use in the United States and has specified a Metric Conversion Policy along with Federal Agency Guidelines for Implementation of Metric Conversion Policy in 1981 and updated in 1985. The policy is to facilitate the voluntary transition to the use of metric system of measurements by Federal agencies. Use of the metric system in the Federal agencies is increasing.

I would add that an OSTP report on the use of metric ionizing radiation units has just been completed by the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC). The report, which I am transmitting to the Department of Commerce for implementation, recognizes the increased use of the metric system in radiation measurements and recommends dual (that is both present and metric) radiation units in Federal activities.

AIDS

QUESTION: The FY 88 R&D request will allocate a minimum of $470 million towards research and health measures for AIDS. This amounts to just under 1% of the total federal R&D budget (approximately .8%). What impact will this investment have on the overall HHS budget? You have noted publicly that, "HHS will have authority to increase AIDS spending in mid-year without the delays normally associated with reprogrammings or budget amendments."

Could you elaborate on what this statement implies? Will certain criteria be necessary? Will increased funding be tied to vaccine production? How is research progressing at this point?

ANSWER: The President's request for the Public Health Service programs for AIDS for FY 88 totals $533 million. In addition, the request includes an FY 87 supplemental transfer of up to $100 million from existing funds to be used for rapidly breaking AIDS research opportunities. Congressional approval of this request simply provides PHS with the flexibility to respond expeditiously to a very serious health problem. The reprogramming will be made only after careful consideration of all the priorities within PHS.

Barring a miracle, there will be no vaccine ready for production in FY 87. Current predictions for a vaccine for general use are 7 to 10 years at the earliest. Increased funding will be tied to research opportunities, perhaps to clinical or animal testing of new therapies or vaccines.

The research is progressing very well at both the basic and applied levels.

- The virus has been identified.
- Modes of transmission have been identified.
- Two tests, ELISA and Western Blot, are available for testing individuals and the blood supply. Others are being developed.
- The blood supply is essentially safe.
- Over 300 drugs have been screened for human use. FDA provided rapid approval for use of AZT as an experimental therapy.

- Most promising drugs are being tested on AIDS patients. Fourteen institutions have been designated as AIDS centers where controlled drug tests will become available for more AIDS patients. ($100 million over five years.)
- Promising results for a vaccine using components of virus in monkeys have led to testing in chimpanzees.

AVIATION

QUESTION: The President has said that the development of an aerospace plane is a high priority program. The air-breathing plane would take off from an airport using airbreathing engines and eventually fly into space at Mach 25.

a. What priority level do you place on developing the aerospace plane?

b. The technology used to develop the aerospace plane could be used in the next generation space shuttle. Do you think that this is an important application and would you put a high priority on such a program?

ANSWER: The development of the aerospace plane is a very high priority item for both military and civil aerospace applications as can be seen from the increases in the NASA and DOD funding requests in the FY 1988 budget.

b. The aerospace plane program is focused on providing a more routine and significantly less expensive alternative to the current space shuttle or expendable launch vehicles. Reducing the high costs of getting into space is essential for expanded military and civil space operations, and is the major focus for the next generation space shuttle. Critical aerospace plane technologies such as high-temperature, light-weight materials and thermal structures, flight electronics, and computational tools will directly benefit all air-breathing and rocket-powered concepts under consideration for the next generation space shuttle.

BASIC RESEARCH

QUESTION: How should granting agencies like NSF balance their distribution between the funding of "centers" and principal investigators? To what degree should geographic balance enter into decision-making? Is Congressional earmarking for university projects a useful corrective to the concentration of grants provided to schools in the "old boy network"?

ANSWER: Although S&T centers like the NSF Engineering Research Centers and the NASA Centers for the Commercialization of Space are an important trend for strengthening our competitiveness, the individual investigator, discipline-oriented research programs will always be the primary mode for federal funding (by perhaps an order of magnitude). We feel that the primary criterion for the awarding of federal funds should be the evaluation by a system of peers (the peer review system). The system admittedly has weaknesses, such as the potential for misuse by an old-boy-network, which must constantly be guarded against, but it is the best means of guaranteeing excellence in research. The tendency for Congressional earmarking has the potential for eventually destroying the preferred peer-review process, for making inefficient use of national resources, and for producing poor quality research projects.

BIOTECHNOLOGY/RISK ASSESSMENT

QUESTION: In 1984 and in 1986, OSTP published proposed guidelines for coordinating the federal government's framework for regulating biotechnology, particularly the deliberate release of genetically altered organisms into the environment.

1. The June 1986 Federal Register notice solicited public comments on the policies announced in the notice. Does OSTP presently contemplate publishing revised guidelines as a result of considering the public comments received?

2. With respect to future decisions relating to biotechnology issues, what do you see as the respective roles and responsibilities of:

   a. The Biotechnology Science Coordinating Committee
   b. The Federal Coordinating Council for Science, Engineering, and Technology
   c. The Domestic Policy Council Working Group on Biotechnology
   d. The Office of Science and Technology Policy
   e. The regulatory agencies with statutory responsibilities for biotechnology products, such as, EPA, FDA, OSHA and USDA?

ANSWER: All the comments received on the 26 June 1986 Federal Register Notice have been shared with the various agencies. They are considering them in their current activities relating to regulation of biotechnology research and products.

The Biotechnology Science Coordinating Committee was chartered as a committee of the Federal Coordinating Council for Science, Engineering, and Technology to serve as a coordinating forum for addressing scientific problems, sharing information, and developing consensus; to promote consistency in the development of Federal agencies' review procedures and assessments; to facilitate continuing cooperation among federal agencies on emerging scientific issues; and to identify gaps in scientific knowledge.

The BSCC chairman reports to the Director of OSTP as chairman of the FCCSET. Although two members of the BSCC, the Assistant Secretary of Agriculture for Science and Education and the Director of the National Institutes of Health, are members of the FCCSET, and several other members of the FCCSET have responsibility for R&D programs and policy related to biotechnology, it is unlikely that the FCCSET as a group will have any role in future decisions relating to biotechnology issues.

The Domestic Policy Council Working Group on Biotechnology, chaired by David Kingsbury, Assistant Director of the National Science Foundation for Biological, Behavorial and Social Sciences, will continue to have responsibility for policy matters related to agency jurisdiction, commercialization, and international biotechnology matters. The Working Group monitors developments in biotechnology and is ready to identify problems and make appropriate recommendations for their solution.

The Director of OSTP, as chairman of the FCCSET, is ultimately responsible for the activities of the BSCC; OSTP staff acts as its Executive Secretary. In addition, the Director shall provide timely advice to the President on policy and budget issues relating to biotechnology. He will assess and advise on policies for international cooperation in biotechnology.

The regulatory agencies, EPA, FDA, OSHA, and USDA, will continue to review biotechnology products on a case-by-case basis using their current statutory authority as outlined in their policy statements published in the Federal Register on 26 June 1986. At the present time, existing statutes are adequate to deal with the emerging processes and products of modern biotechnology, but in a fast moving field there always can be potential problems and deficiencies in the regulatory apparatus. The Working Group will be alert to the implications that such changes may have on regulation and will make recommendations for administrative or legislative action.

QUESTION: On June 26, 1986, OSTP published a "Coordinated Framework for Regulation of Biotechnology." This framework reflected the work of the Biotechnology Science Coordinating Committee (BSCC) which coordinated the regulatory policies of various agencies. Most, if not all, of the BSCC's work was conducted in closed meetings. What does OSTP, as supervisory body for the BSCC, intend to do to open the BSCC's deliberations on regulatory policy to public scrutiny?

ANSWER: At the first meeting of the BSCC in 1987 (on January 5), to which the public was invited, the Chairman announced that most, if not all, of the future meetings of the BSCC would be open to the public. OSTP believes that open meetings, to the maximum extent possible, are in the best interests of the public.

QUESTION: While there has been considerable effort made to encourage government and academia cooperation with industry in developing biotechnology products and processes, there has been virtually no effort to promote cooperation in the area of assessing the risks of releasing genetically engineered products into the environment. What plans does OSTP have to promote such risk assessment so that our regulatory policy can be based on firm data and experience?

ANSWER: Prior to OSTP's publication on June 26, 1986, of the Federal Register notice, industry voluntarily has complied for many years with the NIH (RAC) Guidelines, and has closely consulted with the RAC. A RAC subcommittee has studied and subsequently reported its "points to consider" as guidance to all who contemplate intentional environmental release. These were published in the Federal Register, part II, Vol. 50, No. 60, March 28, 1985.

In addition, a joint meeting of delegates representing the BSCC, the National Library of Medicine (NLM), and the Commission of European Communities soon will be held at the Library. The group will consider the feasibility of developing a data bank based on the existing and to-be-published literature of environmental biology pertinent to risk assessment using methods and equipment NLM has developed for on-line biomedical data retrieval.

As is noted in the Administration's proposed FY 1988 budget, the NSF, USDA and the Department of Energy jointly have agreed to increase funding for plant science. They plan to establish university-based centers with cooperative activities between State and local governments, Federal government and industry. One of the types of centers would be concerned with "Rhizosphere Dynamics and Microbial Ecology." In part, research and training would be dedicated to the natural history and horizontal gene transfer of microbial populations in soils, and plant-microbial interactions. Data generated are expected to contribute significant information applicable to risk assessment protocols. OSTP has been closely involved in framing this budgetary initiative.

In several workshops and research conferences (e.g. Gordon Conferences) industrial scientists have been leading participants. For example, at the NSF/OTA workshop on horizontal gene transfer (November, 1985), industrial scientists described their methods of risk analysis and proposed risk management procedures.

QUESTION: The U.S. is a leader in the development of domestic regulatory policy for biotechnology. However, international efforts to construct regulatory guidelines for biotechnology have been delayed due to confusion among and within the U.S. delegation to the OECD. What role does OSTP plan to play in helping this nation regain its initiative and leadership in the development of an international regulatory policy for biotechnology?

ANSWER: The "confusion among and within the U.S. delegation" was eliminated over a year ago under the leadership of FDA Commissioner Frank Young. In December, 1985, the U.S. delegation put forward an internally agreed upon position which was essentially adopted by the OECD conferees. After subsequent discussions resulting in relatively minor modifications, the OECD Council approved for public release and published the agreement ("Recombinant DNA Safety Considerations") last year.

The BSCC Chairman has held discussions with the Commission of the European Communities aimed at developing and exchanging research data to be

shared formally and informally between the U.S. and EC nations. We view this developing effort as an important international activity in this calendar year.

We don't believe that the U.S. has ever lost its initiative and leadership in developing a regulatory position that serves as a model for other nations. For over a decade, the NIH has maintained an Office of Recombinant DNA Affairs whose activities have resulted in guidelines adopted not only by NIH, but by all Federal agencies supporting relevant research. Through the years, this work has been closely followed by all industrialized countries. Following the U.S. lead, they too initially adopted a conservative attitude but have agreed with our gradual relaxation of research proscriptions and restrictions. As Federal agencies continue their efforts to evolve guidelines and publish regulatory rules within the coordinated framework for regulation mindful of environmental protection, other nations will be kept informed. We encourage their deliberation of the issues with us.

QUESTION: Planned releases of genetically-engineered organisms have been repeatedly blocked over concerns about environmental risks. The resources devoted to biotechnology risk assessment research in the FY 1988 budget requests for EPA are extremely modest, yet represent the great bulk of Federal research effort in this area.

a. Given the need to test biotechnology products safely, isn't there a need to expand the Federal research effort to develop environmental risk assessment information for biotechnology products?

b. What role can the private sector play in conducting environmental risk assessment research for biotechnology products? Is this an area which could be improved or expanded through a cooperative government-industry effort?

ANSWER: Two introductory points must be made. First, firms and academic researchers planning environmental release experiments have a social responsibility to fully explain their intentions and the nature of their work to the public. They also have a responsibility to comply with Federal regulations and to coordinate closely with local

institutional biosafety committees charged with oversight, review and approval of experiments. Risk assessment research funding and data generation will not substitute for failures of firms and individuals to act responsibly.

Second, the community of scholars in environmental biology is small compared to that in biomedicine. That part of the environmental science community at all concerned with implications of biotechnology is even smaller.

The National Science Foundation continues to be the source of about 90% of Federal funds obligated for basic research in environmental biology. Most of the money is used to support academic researchers, student and postdoctorate training, and facilities maintenance and refurbishment. The FY 1987 current plan for these activities is about $65 million allocated to ecology, systematic biology, population biology and physiological ecology, ecosystem studies, and support of such resources as research herbaria, collections of living organisms, and the like. The total population of professional senior investigators supported by these funds is only 650.

Obviously, a community of this size, historically dedicated chiefly to intellectual pursuits unrelated to biotechnology, will be turned to research applicable to regulatory concerns slowly and with difficulty. The same community also consults with, and is partly funded by EPA, USDA, the Smithsonian Institution, and the Departments of Energy and Interior. We agree that the Federal research effort should be expanded but it is not practical to increase all relevant agencies' budgets to develop environmental risk assessment information. It <u>is</u> practical, however, to increase funding of that agency, NSF, which supports the great majority of research projects in environmental biology. The Administration's proposed budget for FY 1988 does this, and will continue to do so in its proposal to double NSF's budget over the next five years.

The funds proposed for EPA in the FY 1988 budget for biotechnology risk assessment do not represent the great bulk of Federal research effort in this area, as suggested. We believe that the (approximately) $1.5 million obligated by EPA that contributes risk assessment information may actually be less than one-half the Federal total. We suggest that about $1.5-2 million of NSF's

obligations for biotechnology-related research contribute to environmental risk assessment. These obligations incremented by other agencies provide strong reason to attempt to capture generated data by building an on-line data base with advice from the National Library of Medicine. The BSCC Subcommittee on Research and Research Needs is acting as a coordinating body to insure maximum synergy and to achieve maximum return on investment by both EPA and NSF.

The private sector already plays an important role in risk assessment of biotechnology products. Their applications for permission to field test contain valuable data on effects, dispersal and recovery of genetically engineered biota from laboratory, microcosm and greenhouse studies. Such data will be augmented from field trials. We would look favorably on cooperative efforts of government and industry; through the proposed plant science and technology centers to be funded by NSF, DoE and USDA, we believe such efforts can be realistically based at universities. But we have found little enthusiasm by industry to engage in generic studies that have no direct relevance to one of their specific or potential products. The biotechnology industry is still in its infancy. Because it is, with few exceptions, comprised of small firms whose profit margins are thin at best, it is not in their immediate interest to invest funds in generic risk assessment research.

QUESTION: What improvements and clarifications are needed in the Biotechnology Science Coordinating Committee (BSCC) framework? Are agencies moving quickly enough with rulemaking? What improvements are needed in the scientific understanding of risk assessment? Does biotechnology require more scrutiny than earlier biological advances, such as creating plant hybrids? Are any statutory changes needed to improve the regulation of biotechnology?

ANSWER: The Coordinated Framework for Regulation of Biotechnology (Federal Register, June 26, 1986) states in the Introduction that the framework is expected to evolve and that modifications may need to be made. Since the end of September, 1986, the agencies have been studying the public's written responses

filed during the comment period with intent to publish rulemaking for additional public review, and other clarifications on review processes and procedures.

It should be noted that the "framework," as an expression of comprehensive federal regulatory policy, was formulated under the Domestic Policy Council. The BSCC's role is defined in its charter and is concerned with scientific matters as described in the November 14, 1985, Federal Register notice. It is expected that the agencies will carefully consider the comments received on BSCC's suggested and published definitions of "intergeneric organism" and "pathogen" during the rulemaking process.

Rulemaking is complex for a single agency. These definitions may strongly affect an agency's regulatory guidance to the public, as may questions or aspects of risk perception, assessment and management, and of terms such as containment and release. To be effective, a coordinated framework must have interagency consistency in its application of scientific knowledge and principles to rulemaking.

Considering that scientific consensus building is a deliberate process involving reconciliation of diverse opinions, we believe that progress to date has been satisfactory.

Needed improvements and activities in the scientific understanding of risk assessment have been addressed in answers to other questions.

As indicated, scrutiny or oversight is required because more than one agency has regulatory authority in biotechnology, and the underlying science and the review process have to be applied consistently and in a coordinated fashion.

We do not believe at this time that statutory changes are required.

EARTH SCIENCE AND ENVIRONMENT

QUESTION: What steps need to be taken to coordinate the various activities in the Earth Sciences such that we can develop a vigorous international Geosphere Biosphere Program?

ANSWER: The Federal Coordinating Council on Science, Engineering and Technology Subcommittee on Oceans and Atmospheres is playing an important role in the coordination of interagency activities in the earth sciences. We are restructuring this committee to also include the third major element of earth sciences, i.e., the land processes.

QUESTION: In October, 1985, OSTP completed a report entitled "Earth Sciences Research in the Civil Space Program". The key finding of the report was that there is a growing capability for space-based measurements to forecast mankind's effects on our global environment (ozone changes, acid rain, deforestation, carbon dioxide increases, etc.).

a. What specific actions have been taken as a result of your report? (i.e., have agency missions and activities changed to take your strong recommendations into account?)

b. Many scientists believe that this program is a three-legged stool--NASA, NSF, and NOAA--and that NOAA, in terms of its ability to develop new programs and responsibilities, is a very wobbly leg. Do you agree with this assessment of NOAA, particularly in light of the major responsibilities which you assigned to NOAA in your report?

ANSWER: The OSTP report "Earth Sciences Research in the Civil Space Program" has been taken up by SIG(Space) and no actions will be taken vis-a-vis the recommendations pending the outcome of their review.

EDUCATION

QUESTION: The university groups and OMB seem to have reached an accord on indirect cost reimbursement for administrative expenses (Circular A-21). Are you satisfied with this agreement? How long do you expect it to remain in effect?

ANSWER: This agreement to eliminate faculty effort reporting and to fix the indirect cost rate at 3.6% for administrative work of department heads, faculty, and professional research staff provides a satisfactory compromise in an area that has long been a source of contention among university administrators, researchers, and federal agencies. I do not expect any change in this area in the short term.

QUESTION: A National Science Board subcommittee last year recommended significant increases in the funding that NSF devotes to education. Are you satisfied with the education programs at NSF? What more can be done to improve the quality of precollege education? Should the federal government provide scholarships to top students who agree to teach math and science in return for the grants?

ANSWER: I am satisfied with the trend at NSF toward increased support for education programs. The quality of precollege education is a responsibility shared by federal, state, and local governments, by industry and academia, and by students and their parents. The quality of precollege education can only be improved if all these groups demand excellence in their respective roles.

Providing scholarships to top students in return for an agreement to teach math or science for a few years does little to attract and retain talented teachers who will make a long term commitment to excellence in math and science education. A better use of both private and public funding is to provide a working environment and a pay scale that will attract top students into the profession.

QUESTION: As we face an increasingly technological future, many of us think that our greatest national weakness is the low level of scientific and mathematical learning by our young people at the primary and secondary school levels. Any number of studies seem to bear this out.

a. Do you agree that this constitutes a serious problem? If not, how do you view this situation?

b. If you regard science and math teaching in the lower grades as a serious problem, what do you think is the root cause?

c. Does the Federal Government have a responsibility in addressing the problem?

d. If so, does the budget reflect an appropriate level of concern?

ANSWER: I agree that the results of recent studies are cause for great concern. The level of achievement of our students in math and science falls below that of many of the countries with whom we must compete in world markets.

There is no single reason for our students' poor showing and no simple solution. The problem lies in attitudes and expectations of both students and parents, in the style and quality of classroom teaching, in our choice of a curriculum that emphasizes only arithmetic for the first eight years and that treats science as little more than a memory drill. As a society, we attribute academic success to ability while others, most notably Japan, consider effort to be the main factor in achievement.

The choice of curricula, standards for hiring and evaluating teachers, and funding for computer and laboratory equipment are the responsibilities of state and local governments. The federal role includes providing funding for curriculum development for both students and teachers, for national and international studies on achievement, attitudes, and curricula, for financial support for students at the undergraduate and graduate level, and for programs that recognize outstanding accomplishments, and encourage leadership roles for outstanding faculty, e.g., the Presidential Awards for Excellence in Science and Mathematics Teaching and the Presidential Young Investigators Fellowships. The burden for these activities does not fall solely on the Federal Government, but on industry, trade associations, private foundations, professional societies, and our colleges and universities.

Given the financial constraints under which our budget decisions are made, the FY 1988 budget provides a sound level of support for our federal activities.

QUESTION: In March, 1986 the National Science Board issued a report by its Task Committee on Undergraduate Science and Engineering Education. The report, entitled "Undergraduate Science, Mathematics and Engineering Education", described problems affecting science and engineering education at four-year institutions and set forth a number of recommendations for the National Science Foundation. In response the NSF incorporated into the budget request for fiscal year 1988 a package of actions addressing undergraduate education. The package includes: grants for instrumentation, student research experience, faculty enhancement, and curriculum improvement. Given the importance of science and education at four-year institutions, what priority do you place on undergraduate education programs at NSF and other federal science agencies? What other federal agencies have similar programs aimed at undergraduate science and engineering education?

ANSWER: The largest percentage increase in NSF programs for FY87/FY88 is proposed in the President's budget for the Science and Engineering Education Directorate (+ 50%). This may be the largest percentage increase in any budget item. Thus, undergraduate education programs at NSF have a high priority. One of the reasons for this high priority is the that NSF funds primarily support university research. Following the White House Science Council's report on the Health of U.S. Universities, the NSF became a focal point to improve federal support for our university system (including four-year institutions). The 17% FY88 increase and the promise to submit budgets which double the NSF budget over the next 5 years is also consistent with our improved national competitiveness. Other agencies, with missions related to defense, health, energy, etc., would not have been as clearly appropriate for such a direct improvement for academic research support.

ENERGY

QUESTION: We know now that the gasoline and energy shortage of the previous decade was artificially induced. In your view, could it happen again? Overall, the budget reflects a further decrease in federal support for developing alternative sources of energy and energy fuels. Are we properly postured to deal more effectively with - or prevent - another energy crisis? What is the Federal Government's responsibility in dealing with the problem on both a short-range and long-range basis?

ANSWER: The U.S. can never fully protect itself from artificially induced energy shortages. However, the country continues to posture itself where it can meet an increasing fraction of its energy needs from domestic supply. We continue to strongly support research on increasing the efficiency and safety of both hydrocarbon and nuclear power systems.

QUESTION: Dr. Graham, is our national energy policy predicated on a market-oriented approach with no real urgency for development of alternative sources as long as oil is only $15-20 a barrel? I would like you to comment on that because I am concerned that over the past five years we have weakened our programs in nuclear fission R&D and magnetic fusion, fossil energy, energy conservation and renewable technologies, while squandering an opportunity in synthetic fuels development.

ANSWER: We do have a policy, which is not to artificially subsidize demonstration plants (such as the synfuel pilot plant), which cannot compete with established technologies. We do continue to support R&D for the identification of new technologies or improvements in the existing technologies. As an example, the recent development of improved superconductors will impact the area of magnetic fusion, fossil energy in magnetohydrodynamics (MHD) generation, energy conservation.

QUESTION: Dr. Graham, there has been a lot of talk about the privatization of uranium enrichment activities which are presently conducted by the federal government.

Are you satisfied that the DOE is making a good faith effort to work with industry in terms of the use of our existing gas centrifuge machines and manufacturing equipment?

I have heard that the DOE may be on the verge of saying "no" to such privatization efforts.

ANSWER: OSTP supports the stated Federal policy to encourage privatization of appropriate government activities. We believe that DOE is making a good faith effort to work with industry in using the gas contrifuge equipment at the Portsmouth, Ohio, plant. Over the long term we hope to see a competitive U.S. private sector enrichment business which can generate new tax revenues for the U.S. Treasury.

The Administration believes that the private sector should develop capabilities using existing technologies. DOE should support R&D to develop new technologies for isotope separation, e.g., chemical reaction whose yield depends on isotope mass. This has been demonstrated recently.

QUESTION: How can the U.S. regain its share of the uranium enrichment market over the long term?

ANSWER: We must utilize the new technologies which are more efficient, e.g., enrichment by chemistry.

QUESTION: Is it feasible for private industry to control the uranium enrichment enterprise when the process has national security implications?

ANSWER: Why not? Private industry builds ships, planes, missiles, etc.

QUESTION: What is OSTP's role in educating the public on the role of nuclear energy in our society?

ANSWER: This is primarily a role for the responsible agencies

QUESTION: What can be done to address the institutional problems surrounding our civilian nuclear waste disposal program?

ANSWER: Again, this is primarily a role for the responsible agencies, but there is a clear need to better educate the public on this issue.

ENVIRONMENT

QUESTION: The Congress established a Chief Scientist position for NOAA last year. When will the Administration fill this position?

ANSWER: The Administration is actively searching for a chief scientist.

QUESTION: One of the most important issues facing us is destruction of the ozone layer and global warming. NOAA is a key player in understanding these phenomena. Other agencies are requesting increases to study these areas. Why isn't NOAA?

ANSWER: NOAA is a participant in both of the activities, but DOE, NASA, and NSF also have substantial programs. I would conclude that NOAA reviewed their other research priorities and concluded that their research efforts on ozone and global warming were adequate at this time.

QUESTION: Last year the Administration proposed to end the subsidy for LANDSAT. Why has the Administration changed its position?

ANSWER: From 1972 to 1985, the U.S. Government has funded the development, procurement, and operation of the LANDSAT satellite system. The research and development efforts by the Government have paved the way for commercial applications of remote sensing systems, and the private sector can now utilize these R&D results for commercial applications.

QUESTION: The 10-year Federal acid rain research program is now in its seventh year. When will the Administration decide whether action is necessary to address the acid rain problem?

ANSWER: The Administration continues to address the broad range of acid rain problems, including the designation of major resources for the solution of regional problems near the Canadian border.

QUESTION: What is OSTP's role in coordinating the global change research program within the Federal agencies? When will EPA decide whether actions are needed to address the global warming problems?

ANSWER: OSTP prepared a report entitled "Earth Sciences in the Civil Space Program" and submitted it to SIG(Space). This report calls for OSTP to play a strong coordinating role in earth science research.

FEDERAL EDUCATION AND MANPOWER SUPPORT

QUESTION: With several countries now pulling even, and in some cases ahead of the United States, what steps do you see as necessary to make sure that American scientists and engineers in industry, government, and in the universities, can keep up with advances made in these countries?

ANSWER: The prime factor is to maintain a healthy level of funding for research so that scientists and engineers in the universities can attract the best students and maintain quality laboratory environments. We must continue to foster close working relationships between industry and the universities and national laboratories to expedite the flow of new knowledge and technologies from the laboratories into products and services.

QUESTION: For our "best and brightest" the availability of fellowship support and future employment hinges very much on the prospects for future federal funding. In that field, are we doing enough to show young people about to enter graduate school that applied research and engineering has equally good promise of fellowship support and long-term research support?

ANSWER: In his Competitiveness Initiative message, the President proposes the establishment of a number of new university-based, interdisciplinary science and technology centers. These centers will perform long-term science and engineering research. I believe that the emphasis on engineering research in these centers will encourage young people to consider postgraduate education in applied research and engineering fields.

QUESTION: What can be done to increase the participation of minority students and women in science and engineering? To what degree should these efforts concentrate on traditionally black institutions?

ANSWER: OSTP has been working with the White House Initiative on Historically Black Colleges and Universities (HBCUs) in the Department of Education to address the underrepresentation of blacks in certain disciplines of science and technology (e.g., physics, math, chemistry, engineering). In September of 1986 we co-sponsored a national conference entitled HBCU Alliances with Frontier Sciences at the National Academy of Sciences to examine the effectiveness of cooperative programs between traditionally black institutions, federal laboratories, and corporate research programs. Several recommendations from that conference are under consideration for implementation.

OSTP has also initiated the Task Force on Women, Minorities and Handicapped in Science and Technology as required by PL 99-383. This task force will be examining the use and coordination of federal agency programs to improve the participation of all three groups in S&T. The Task Force will consider the short-term problems of retention and the long-range problems of entrance into the pipeline. It will not merely conduct one more study, but will rather be an action oriented group which will recommend, review, and evaluate changes in each of the federal agency programs.

QUESTION: What problems do you believe the tax reform act will cause for students and universities? Should steps be taken to remedy these problems? Is OSTP planning to get involved in the Ways and Means Committee's proposed hearings on whether more activities of colleges and other non-profits should be subject to taxation?

ANSWER: Tax reform will undoubtedly have some effect on students and universities since some contributors who made donations because there was previously a higher tax write-off may now reduce or stop their contributions. We do not believe, however, that this class of contributors represents the majority. We further believe that the effects of tax simplification and the removal of hidden subsidies in this and other areas is in the best interests of the nation and, in the end, of the universities. OSTP does not normally participate in the Ways and Means Committee's hearings except where they relate to science and technology policy. We note that the President has taken the position that he will continue to support the R&D investment deduction at the 20% level for new investment as is currently the law.

GENERAL SCIENCE

QUESTION: Your predecessor, Dr. Keyworth, had a deep concern about our federal laboratories. He sponsored an in-depth study under the chairmanship of David Packard. What is your view about our federal laboratories? Are there too many? Too few? Are they redundant? Do they do what should be done by private industry? Do they do what should be done by universities? Do the federal laboratories have the proper focus? Have their missions been defined appropriately and do they recognize their missions?

ANSWER: The federal laboratories serve a special "big science" research role which neither can nor should be carried out by universities or private industry. They support our nuclear deterrence capability and provide access to large and specialized scientific instruments such as reactors, accelerators, or projects which require hundreds of persons working to meet specific milestones. They also support high-risk basic research which requires special capabilities and therefore may (or may not) lead to commercial products or processes, research which, for this reason, is often unlikely to be supported by corporate directors who must show profits on shorter time scales. They generate new knowledge, sometimes assist in the training of graduate students, and often transfer knowledge to the private sector. Generally, these missions do not conflict with the role of either academic or industrial R&D but rather complement them.

This is not to say, however, that there is not room for improvement in our national labs. We feel that the Technology Transfer Act of 1986 will assist in providing incentives to researchers at the labs which will correct some of these problems. There are also a number of alliances being formed between federal labs, universities and private corporations which allow the institutions to make their individual roles clearer and complementary. The President's "Quest for Excellence" message to Congress details several specific actions which are being taken by the Administration to enhance the cooperation between the national laboratories and industry.

Many of the recommendations of the Packard Commission have now been implemented as reported by OSTP in 1985, but a few remain. One persistent problem is the magnitude of the compensation package needed to attract and retain the best and brightest researchers.

QUESTION: The Administration is proposing a commitment to double the budget of the National Science Foundation over the next 5 years. How was the recommendation arrived at? To what extent would the research budgets of the other federal science agencies (NIH, NASA) and the federal department and agencies with strong science interests (HHS, Transportation, Energy, Agriculture, DOD, EPA, and VA) be affected by such a commitment?

ANSWER: The recommendation to double the budget of the NSF came about as a result of recommendations to the President from the Economic Policy Council's review of actions needed to strengthen the Nation's industrial competitiveness. The recommendations from the Health of the Universities (HOU) study by the White House Science Council and the President's Commission on Industrial Competitiveness were important inputs in this process. These reports considered the crucial role that universities play in stimulating our economic competitiveness. After leaving the assessment by considering the federal budget deficit and the need to continue an adequate funding growth of the other agency R&D programs, we concluded that a doubling of the NSF budget over five years would constitute a prudent response. I would like to remind the committee that NSF is primarily a basic science institution with an R&D funding level which is approximately one third of that of DOE, DHHS, or NASA but which provides nearly half of the total funds to universities. We felt that a significant growth in NSF funding would thus provide the largest lever to directly improve the support of universities. This choice did not directly result in a reduction in funding for any other agency but rather a larger growth for science and technology than would otherwise have resulted.

QUESTION: The Administration has followed a policy of deemphasizing applied research and development, saying that such activities should be done by the private sector. Yet in the two historical instances when the nation was confronted with major technological challenges, World War II and Sputnik, we followed the

opposite policy and put our scientists to work on applied, high technology development. Why should we not give strong and equal emphasis to federal support of applied research and development?

ANSWER: The emphasis on S&T centers and technology transfer activities in the President's FY 1988 budget initiative strongly supports applied research.

QUESTION: If the federal support for science is to increase significantly, will that not send a signal to industry that they need not do very much in that area, and that the universities that have sought financial support from industry need not continue to seek such support?

ANSWER: On the contrary, strong Federal support for science will send the message that it is viewed as important, and will encourage industry to add their support. We have seen evidence of this support in industry's strong participation and investment resources in the Engineering Research Centers initiated by the National Science Foundation.

QUESTION: The fiscal year 1988 budget includes funds to establish 5 to 10 new interdisciplinary basic science and technology centers through the National Science Foundation (NSF) and modeled after the existing engineering centers.

a. Has your office evaluated the contribution the existing engineering research centers have made to economic competitiveness and technology transfer?

b. Increased use of the "center concept" could mortgage considerable funds from future years and funds available for individual research projects. What would be the appropriate balance between centers and individual projects? What criteria would you use to establish a balance and monitor the resulting productivity? What agency should be responsible for monitoring the "center concept" within the federal research and development complex?

ANSWER: a. It is too early to evaluate in detail the contribution of the ERCs. However, each Federal dollar continues to be matched by about $1.25 from industry. We think that the continued support of the centers by

industry is an indication that industry continues to believe in the ERC potential.

b. The predominate means of federal support for universities will always be the single investigator, discipline oriented research. Nearly every segment of the basic research programs continues to grow annually and the budget we submitted on Jan. 5, 1987, is no exception. Naturally we will have to continually monitor the productivity of the centers and feel that each agency should be responsible for its own programs and for its own balance in terms of its mission and needs.

QUESTION: In your January 5, 1987, news conference on the fiscal year 1988 research and development budget, you stated, "More than half of federal support for basic research goes to universities; and from 1982 to 1988, the amount of federal funds allocated to basic research will have grown by more than 50 percent." A January 19, 1987, news release of the National Science Foundation, reporting results of NSF's Survey of Federal Obligations to Universities, Colleges, and Selected Nonprofit Institutions reads: "The expected 1986-87 decrease (3% after adjustment for inflation) continues the trend of fluctuating federal levels of support for academic R&D activities during the 1980's. The decade began with a real decline averaging nearly four percent annually during 1980-82. From 1982 to 1985, the average annual real growth rate was nearly eight percent, but there was no growth, in real terms, from 1985 to 1986."

ANSWER: In the January 5, 1987 news conference on the fiscal year 1988 research and development budget we stated that more than half of the federal support for basic research goes to universities, according to experience over the past few years (FY 85, FY 86, and an estimate for FY 87). We also said that from 1982 to 1988, the amount of federal funds allocated to basic research will have grown by more that 50 percent based on the assumption that the Congress would eventually concur with the Presidents budget request.

According to the Science and Technology DATA BOOK for 1987 issued by the Division of Science Resources Studies of the NSF:

o The average annual percentage change for Federal R&D obligations for basic research in constant 1982 dollars was +6.6% between 1982 and 1986.

o The estimated annual percentage change for Federal R&D obligations for basic research in constant 1982 dollars was -0.5% between 1986 and 1987.

o The average annual percentage change for Federal R&D obligations for basic research to universities in constant 1982 dollars was +3.9% between 1977 and 1987.

Any trend of fluctuating federal support for academic R&D during the 1980s was not brought to science by recommendations of the Reagan administration, which recommended real positive increases in each of those years.

QUESTION: What is the OSTP doing to achieve better coordination of the federal agencies supporting basic research?

ANSWER: OSTP coordinates research programs of the Federal agencies through the Federal Coordinating Council on Science Engineering and Technology (FCCSET) committees. Ten committees are currently active and include topics such as: oceans and atmospheres, supercomputer, radiation safety, regulations for biotechnology, international competitiveness, and materials. As the national needs change, new committees are formed or existing committees are redefined.

INTERNATIONAL

QUESTION: In the years since 1945, the United States has had extended science cooperation agreements with many countries, including many, such as Germany and Japan, which have now become serious competitiors in high technology products. As a matter of national policy, does it make sense to continue to cooperate internationally in science, if the result simply is to help future competitors?

ANSWER: Scientific endeavor has always crossed national boundaries. The accelerating rate of scientific advance today is due in large part to the increasing ease of direct collaboration between colleagues of different nationalities, using the best facilities and resources available in the world.

Foreign countries have contributed much to current U.S. leadership in many fields of science. Many eminent American-born scientists in decades past received a part of their training abroad, and U.S. science has been invigorated by the large numbers of highly qualified scientists born and trained overseas who have chosen to pursue their research in our country.

Today, in many areas of science and engineering, our industrial country allies have attained a level of excellence and achievement that equals and, in some cases, surpasses U.S. efforts. We strongly encourage U.S. scientists and engineers to work with their outstanding foreign colleagues at centers of excellence and unique facilities not available in the U.S. These cooperative programs are designed to complement our domestic science and technology priorities. Thus, they advance the national interest by strengthening our own science and engineering enterprise, and also by providing opportunities to share costs and avoid duplication of effort in large-scale, expensive ventures.

In terms of policy, this Administration begins with the view that U.S. international S&T cooperation should serve four primary objectives: (1) to strengthen the nation's scientific and technological enterprise; (2) to promote our foreign policy goals and improve our international relations; (3) to enhance commercial

relations and establish new trading partnerships; and (4) throughout, to protect and, where possible, enhance our national security.

We are convinced that international S&T cooperation is in the U.S. national interest, and can actually strengthen our competitive position if the guiding principles are properly defined. We are re-examining specific bilateral S&T agreements to ensure that they adhere to those principles which we consider crucial for the long-term viability of the relationship: balance in contributions to the joint effort; equitable access by each party to the scientific resources of the other; reciprocity of benefit to each side; protection of intellectual property.

The industrialized countries of the world have a responsibility to apply a portion of their economic and human resouces to basic research to advance human knowledge and ensure mankind's continued ability to meet the challenges of the future.

Japan is an example of a leading industrialized country that in recent decades has profited enormously from the international basic research enterprise without making commensurate contributions to the world knowledge base. Japan has recently announced policies and measures to correct this imbalance in its international scientific relations. We expect to see these new policies reflected in the next phase of our bilateral cooperation with Japan, where the U.S. is seeking to achieve a two-way flow of knowledge and technology. We are confident that Japan, and other countries with which we address these concerns, will see that it is in their long-term interest to ensure that the overall S&T relationship is equally rewarding to both parties.

As we all recognize, each country's national efforts in basic research are reinforced and strengthened when we pursue international collaboration. The key is equity in access to expertise, facilities, and information. It is reciprocal cooperation that embodies the essence of true collaboration and accelerates the rate of scientific discovery. Each country's national effort helps to enlarge the range of possibilities for all countries.

Once basic principles are discovered or verified, the world's people will benefit most if these discoveries

are efficiently integrated into practical applications. When two countries combine resources to translate basic research findings into useful technologies, the "economic pie" may grow faster than if one country pursues the task alone. In applied developmental research, the most fruitful international cooperation is characterized by an equitable balance of contributions and rewards for both partners. The profitability and potential of commercial science and technology depends in large part on the ability of private firms throughout the world to reap the benefits of technological advances through direct investment, licensing, and consulting agreements.

Formal intergovernmental agreements in science and technology cover only a small part of the cooperative activities in which U.S. scientists are engaged. By far the most significant and widespread international efforts are pursued outside of formal agreements and constitute tangible evidence of domestic science priorities and needs driving international scientific collaboration. The research community at universities and industrial R&D centers have established research networks and informal linkages with colleagues around the world and incorporated the best talent and expertise--wherever it may originate--into the framework of domestic R&D programs. Developing new opportunities to expand and enhance the informal and formal ties that bind the American research community to the world's leading scientists and engineers will continue to be a priority element of the Administration's policies in international competitiveness.

QUESTION: Two years ago the U.S. withdrew from UNESCO, the United Nations Educational, Scientific and Cultural Organization. How have we adjusted for the loss of scientific contacts that have resulted from this, and are there now any plans for rejoining that organization?

ANSWER: American scientists continue to participate in most of UNESCO's science programs, although less prominently than in the past. The U.S. Government is working with the National Academy of Sciences as an intermediary and making voluntary contributions to UNESCO-related scientific activities, to ensure continued access. In 1986, these contributions totaled over $1.2 million. Over $500,000 of that went to nongovernmental research organizations and international cooperative research programs. The balance was contributed directly to the scientific societies participating in the individual programs, where formerly the U.S. support would have been included in their UNESCO subventions. In the FY 1987 appropriation, the total amount for UNESCO-related science activities has been increased to $2 million.

At such time as significant reform of UNESCO is evident, the U.S. is prepared to consider rejoining the organization. Secretary Shultz has appointed a Reform Observation Panel of private citizens to assess UNESCO and to advance the U.S. interest in reform. Steps are underway to extend its mandate beyond its current expiration date of March 31, 1987.

QUESTION: As the Federal government's lead agency for science and technology policy, what role does the OSTP play in coordinating international science activities? Does your office plan to strengthen its ability to play a significant role in this area?

ANSWER: The significance of the international dimensions of science and technology to economic and research competitiveness and to U.S. foreign policy and national security interests have become increasingly apparent in recent years. One result has been the increase in both the number and importance of international science and technology policy issues, research activities, and cooperative programs that cut across federal departments and agencies.

In the fall of 1985, the President's Science Advisor took cognizance of the need for a sub-Cabinet level interagency mechanism to identify, coordinate, and evaluate science and technology issues and activities with significant international implications. This is a function which no single agency or department can perform. Accordingly, in December 1985, the Science Advisor directed and chartered the establishment of the Committee on International Science, Engineering and Technology (CISET) under FCCSET.

CISET's primary purpose is to bring high-level scientific and technical expertise and responsibility in the U.S. government to bear on critical international S&T issues. CISET facilitates integration of U.S. government international S&T activities into the framework of domestic R&D policy and the development of government-wide international S&T policies consistent with the Administration's domestic priorities and budgetary resources. CISET membership, at the level of deputy agency directors and assistant secretaries and above, ensures that, for the first time, top governmental R&D policy officials are being called upon to systematically examine the international implications of domestic R&D policies as well as attendant foreign policy and national security considerations. CISET is carrying out its substantive work largely through four working groups chaired by CISET members and comprised of other senior-level agency representatives. These working groups address the issues of:

-- international science, engineering and technology education, infrastructure and facilities;

-- the role of science, engineering and technology in international competitiveness;

-- bilateral and multinational activities;

-- strategic science, engineering and technology cooperation and technology transfer.

QUESTION: The Science and Technology Committee in the 98th and 99th Congresses was very concerned about the access of foreign governments to American technology and our comparative inability to accumulate even that literature which is in the public domain in other countries. A small first step in this area was taken with the passage of the Japanese Technical Literature Act of 1986, which provided for a modest reprogramming within the Department of Commerce to promote the acquisition and translation of key documents. Your office would seem to be in a unique position to examine the overall problem of the one-way flow of information from this country, as well as our inability to understand and disseminate foreign technical data. Do you expect OSTP to examine issues, such as scientific and technical staffing in U.S. embassies, consulates, and other outposts overseas; coordination of collection activities; dissemination in this country; computer-aided translation of foreign technical literature; and the encouragement of language study by those anticipating careers in science and technology?

ANSWER: Improving U.S. access to foreign technical information is one factor in maintaining our global competitiveness, and OSTP is examining this issue through the CISET and other mechanisms. The President, in his message to the Congress, A Quest for Excellence, indicated that a forthcoming Executive Order will include two provisions to strengthen the collection and dissemination of science and technology information from abroad. The Executive Order will (1) direct the State Department to develop a vigorous recruitment policy to increase the proportion of scientists and engineers from federal technical agencies, academia, and industry serving in science positions in U.S. embassies abroad, and (2) direct the Departments of State and Commerce and the National Science Foundation to develop a mechanism to ensure that information on research and technology abroad is made available in a prompt and efficient manner.

U.S. access to foreign S&T information is only one issue in the broader problem of technology development and innovation. It is unclear how much unmet demand exists in the U.S. for S&T information from abroad, even if translated into English. The pattern seems to be that the larger companies who see a potential application of the information to their own product line, find ways to access the sources they are interested in tracking. Thus, making information from foreign sources more widely available is only part of the answer. U.S. firms not currently seeking this

information must also be convinced that such information is worth the investment of time to peruse, because the information can benefit the firm. The extent of potential benefit to the U.S., of course, will depend on our private sector's ability to translate the information into industrial innovation.

The general lack of foreign language capability in the U.S. population as a whole has ramifications for our country's competitiveness beyond science and technology. This is a national problem, whose causes and solutions are much broader than simply the quality of U.S. scientific and technical training. In the S&T community, America's lack of proficiency in foreign languages hampers not only our access to publicly available technical information, but also the mobility of our scientists. The CISET Working Group on International Science, Engineering and Technology Education, Infrastructure, and Facilities is examining the foreign language question in both contexts.

It is the case with many of the countries with which we have cooperative activities that U.S. scientists do not take full advantage of the opportunities for international exchange, because they are unable to function in the foreign language. Thus, while our international policy in bilateral S&T cooperation agreements is to establish a balanced two-way exchange of personnel and information, we must concurrently take steps domestically to prepare American scientists to work and learn in foreign settings.

INTERNATIONAL COMPETITIVENESS

QUESTION: What actions, besides increasing funding for basic research, should the federal government be taking to improve economic competitiveness? How can we be sure our scientific leadership is exploited by industry? What can OSTP and federal agencies do to ensure that full advantage is taken of the Technology Transfer Act of 1986? What can be done to improve American access to Japanese technical information?

ANSWER: The President will issue an Executive Order to improve industry access to the federal science and technology enterprise:

- To encourage scientists working in federal laboratories to patent, license, and commercialize their research so that the private sector, including consumers, can benefit, federal agencies must implement royalty sharing programs with federal inventors.

- To promote technology transfers and commercial spin-offs from federal research and development efforts, federal agencies and federally operated laboratories will seek out "science entrepreneurs" to act as conduits between the laboratories and business, venture capitalists, and universities.

- To exploit fully foreign science and technology, the Department of State will develop a vigorous recruitment policy that encourages scientists and engineers from other federal agencies, academia, and industry to apply for assignments in U.S. embassies abroad.

- To ensure that our industry and academia benefit from research and technology abroad, the Departments of State and Commerce and the National Science Foundation will develop a mechanism to ensure that information on foreign research is made available in a prompt and efficient manner.

QUESTION: We are excited that the National Bureau of Standards finally has a meaningful increase in its budget and is being permitted to begin new projects without giving up old ones. This should relieve some of the pressure on its historic and important calibration mission. The Committee last year included language requiring the Administration to survey calibration needs across the government and industry and to come up with recommendations on who can pay for this work. Do you expect that your office will assist in any way in this effort?

ANSWER: The National Bureau of Standards survey of calibration needs of government and industry, which is expected to be completed in April, will be reviewed by OSTP.

QUESTION: Advanced materials are key to the nation's defense and economy. Programs such as the Aerospace Plane or the Strategic Defense Initiative are highly dependent on specific developments in advanced ceramics, composites, and electronic materials. In turn, our ability to compete in the international marketplace with new advanced products relies heavily on such materials advances. Many nations, having long recognized this, have established national programs in advanced materials research. What steps, if any, has this Administration taken to establish an advanced materials R&D program plan? The 1984 Critical Materials Act (P.L. 98-373) called for establishing such a plan. Has OSTP evaluated such a plan? If not, why not?

ANSWER: In accordance with the requirements of the National Critical Materials Act (P.L. 98-373), OSTP has cooperated with the National Critical Materials Council through the FCCSET mechanism, specifically the Committee for Materials (COMAT). COMAT has continued in its role of coordinating advanced materials research and development between the agencies, and has worked with the Council in this area. The Council is currently engaged in the development of an overview of the budget and materials programs at each of the agencies.

QUESTION: The freedom to acquire, disseminate and analyze information is essential to scientific progress in any society, but especially in a democratic society such as ours. What efforts will OSTP be making during this Congress to protect scientists from restrictions on the right to access non-classified information, as well as from unreasonable classification of scientific data?

ANSWER: The mechanism already exists to protect scientists from restrictions on the right to access unclassified information. Furthermore, the Freedom of Information

Act contains provisions that require agencies to report to Congress certain cases where information is denied to requesters. It is the responsibility of all government entities to assess the level of classification to be afforded any government document. In applying proper judgment and exercising the required guidelines, government must seek to achieve the proper balance between the interests of citizens where unclassified information may be under consideration, and the national interest where classification may be determined essential. This applies for all citizens, including scientists.

QUESTION: Is there a real commitment within the Administration to emphasize technology transfer from the defense to the civilian sector as well as to critical national industries from civilian R&D programs? How is this commitment being implemented?

ANSWER: The President is directing the Department of Defense, whose investment in R&D, testing, and evaluation will increase about 17 percent this year or more than double since 1982, to accelerate its efforts to "spin off" technologies to the private sector. Previous successful commercial applications of technology developed in Defense R&D programs include:

- High-power permanent magnet materials making possible small and light weight electric motors for products ranging from electric fans to automobile starters. These have also substantially reduced U.S. dependence on foreign critical materials.);
- Night-vision technology for such uses as police work and rescue helicopters; and
- Computer-based reading/training systems for adult education centers, adopted from military personnel development programs.

Technologies targeted for future spin-offs include:

- Ceramic composite materials for higher efficiency auto and turbine engines;
- Lithium batteries that offer 5 to 10 times the energy storage capacity for a given volume or weight;
- Ultra-reliable radar for air traffic control systems and commercial aircraft; and

- Enzymes for improved toxic waste disposal and decontamination.

In addition to the primary function of strengthening deterrence, our Strategic Defense Initiative (SDI) should yield important spin-offs. Like the Apollo and Space Shuttle programs before it, SDI will advance scientific progress across a broad range.

QUESTION: For our "best and brightest" the availability of fellowship support and future employment hinges very much on the prospects for future federal funding. In that field, are we doing enough to show young people about to enter graduate school that applied research and engineering has equally good promise of fellowship support and long-term research support?

ANSWER: Federal funds have supported research with clear economic implications through programs such as the Department of Defense-initiated Materials Research Labs and National Science Foundation Centers for University-Industry Research. Additionally, Engineering Research Centers have been brought on stream within the last two years. The name tells the story in that case.

Now, the President has developed competitiveness initiatives which include establishing Science and Technology Centers as university-based interdisciplinary efforts. These will focus on research programs with economic competitiveness contributions as one of their objectives.

QUESTION: With several countries now pulling even, and in some cases ahead of the United States, what steps do you see as necessary to make sure that American scientists and engineers in industry, government, and in the universities, can keep up with advances made in these countries?

ANSWER: The need to tap into the excellent science and technology now being developed in many nations of the world is paramount to our nation's program to strengthen our competitive position as a supplier to the global marketplace. Industry, the academic community, and government can no longer justify a "not invented here" attitude. The Federal Government can be of assistance to American industry in sharpening the awareness of industry to foreign science and technology developments by engaging in a series of activities. These can range from a new, aggressive staffing of our embassies with scientists and engineers to negotiating bilateral and multilateral S&T agreements designed to provide a useful flow of knowledge back to this country. No more one-way streets. Translation

services can be provided which speed along the flow of overseas developments to our nation's scientists. Expanded science and technology data bases will result from the National Technical Information Service's bilateral exchange agreements covering open literature sources. We need, in general, to raise the awareness of our nation's entire technology community to the important S&T work now being done internationally and encourage its utilization within our borders to insure that high value-added jobs remain at home, thus preserving a high standard of living for all Americans.

QUESTION: In considering our international competitive posture in trade, it seems that our leadership in science does not readily reflect itself in technological excellence. In other words, this nation seems to have undue difficulty in bringing ideas from the laboratory to the marketplace. To what do you ascribe this difficulty? Does the Federal Government have a role to play in addressing the problem, or should it be left to market forces?

ANSWER: The speed with which a nation converts science into technology which then manifests itself as new products, goods and services for the world marketplace, is a function of many factors. What is "new" in the past few years is that many of our international competitors have found significant ways to shorten this time frame. In other words, we're not moving slower; they're moving faster. The responsibility for correcting this "timing" problem must be shared by all elements of our society: business management, labor, the academic community, state and local government, and the Federal Government. The Federal Government must continue to examine its role and institute policy changes where required to further remove barriers to innovation and to catalyze collaborative efforts between all segments of our society. The President's report, A Quest for Excellence, can serve as a road map to help return our nation to a position of world leadership in providing high quality, low cost goods and services to the global marketplace.

QUESTION: What new guidelines have been given to DoD as per the Department of Commerce's view on patent policy within the administration?

ANSWER: As was stated in the President's message to the Congress, A Quest for Excellence, the administration is committed to improving technology transfer from our government-owned, government-operated and government-owned, company-operated laboratories to the civilian sector. This includes programs from the defense laboratories except where we could jeopardize national security. As noted in this message, the Executive Office of the President is preparing an Executive Order which will implement the Technology Transfer Act of 1986.

QUESTION: What role, if any, can SDI play in the development of civilian nuclear reactor technology?

ANSWER: Depending on specific system needs, SDI could play a significant role in stimulating the development of spacenuclear reactor technology to meet power level requirements well above those now available.

QUESTION: The FY 87 Continuing Resolution contained funds $4.5 million of $6.5 million requested) to assure construction of the Cold Neutron Facility at the National Bureau of Standards. Will OSTP play any role in bringing international support to this world class facility?

ANSWER: The NBS cold neutron source is used primarily by U.S. industry. There is currently no plan for OSTP to play a role in developing support for the facility.

LARGE FACILITIES

QUESTION: The U.S. is struggling to keep its lead in supercomputing. What is your evaluation of the government's supercomputing effort, particularly the Advanced Scientific Computing program at NSF? What role do you see for the five supercomputer centers? Should universities be permitted to use federal funds to buy or use Japanese supercomputers? Should supercomputer use be restricted for Eastern Bloc researchers and students? If so, who should enforce these restrictions?

ANSWER: The Advanced Scientific Computing program at NSF has been successful in moving from an initial start-up phase to a fully functional program with several thousand researchers connected to five national supercomputer centers. The program has evolved to the point where OSTP has enlisted the resources of the FCCSET committee on advanced computing to analyze the next phase of operation.

The five national supercomputer centers will serve as a resource for the generation of new technologies for computational science and engineering, offer needed computer time for research projects, provide an infrastructure for the education of students engaged in advanced computer science, and encourage collaboration with industry on joint research projects. Assuming that Japanese supercomputer proposals are submitted reflecting even competition and fair market pricing, universities should be encouraged to evaluate both domestic- and foreign-designed equipment.

Supercomputer use for Eastern Bloc researchers and students should be limited and subject to an evaluation made on a case-by-case basis by the agency involved. Final authority for the outcome of each case should lie with the agency.

QUESTION: It is generally agreed that it is short sighted folly for the Federal Government to support researchers without having a concern for capital considerations. What approach do you favor for dealing with the infrastructure problem?

ANSWER: The agencies, including NSF, have become increasingly sensitive to the deterioration of the infrastructure and are increasing funding for capital equipment.

LONG-TERM ENVIRONMENTAL RESEARCH

QUESTION: In 1985, the President's Council on Environmental Quality issued a report calling for increased attention and resources to "long-term" environmental research and development. The Report noted that "significant gaps in the existing scientific knowledge base cause or exacerbate acknowledged problems of environmental management," and that "long-term" research is needed to resolve these scientific uncertainties.

Much of the recommended research dealt with improving our understanding of environmental processes and effects: how organisms and chemicals move, change and interact with each other in the environment.

a. Does the FY 88 budget request for environmental research reflect the increased support for "long-term" environmental research called for by the CEQ report, particularly for research on environmental processes and effects?

ANSWER: This Office worked closely with the Council on Environmental Quality in the preparation of its 1985 "Report on Long-term Environmental Research and Development." That report was requested by EPA, NSF, NRC, DOE and NIEHS and the implementation of the recommendations has been undertaken by many agencies. EPA is currently reviewing its ecological R&D agenda with the intent of enhancing its programs. The proposed EPA FY 88 budget in fact contains funding for such long-term programs as aquatic toxicology, biotechnology, environmental risk assessment and climatology. In addition, new funding for Superfund research is targeted toward environmental processes and effects.

QUESTION: Over the last six years, the environmental research budget of the EPA has experienced sharp reductions and little growth. In particular, EPA's Grants and Centers program, which supports environmental research in the nation's universities, has been the target for continuing reductions.

a. How can "long-term" environmental research be supported under conditions where funding remains uncertain and levels of funding vary dramatically from year to year?

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ANSWER: EPA funding for the Grants and Centers program has supported little "long-term" environmental research. Much of EPA's long-term programs have been, and continue to be, conducted by EPA's own in-house laboratories. Currently long-term (greater than 5 years) major programs are devoted to understanding climatic changes (impacts due to acid deposition, carbon dioxide, and ozone) ecological interactions of genetically engineered organisms, environmental risk assessment, and aquatic toxicology.

Mapping/Sequencing the Human Genome

QUESTION: The FY 88 budget request for the Department of Energy includes a request for $12 million to support a new research program on sequencing or mapping the human genome.

a. Does the FY 88 budget request funding for similar initiatives in other agencies?

b. What should be the objective of research on the human genome?

c. What should be the respective roles of the Department of Energy, the National Institutes of Health, and the National Science Foundation?

ANSWER: a. The FY 1988 budget request does not indicate a specific similar initiative for any other agency.

b. The question is better posed with objectives (plural) in mind: The intellectual challenge and scientific objectives, the objectives and benefits for clinical medicine, and those for industrial developments.

Scientific/Technical Advances -- Human gene mapping/sequencing would:

- Explain the structure and function of highly repetitive non-coding sequences in DNA.
- Allow critical study of switch-on and switch-off (regulatory) mechanisms in cellular differentiation after conception, and in developmental stages of embryogenesis. Extension to maturation, aging processes and oncogenesis would be obvious candidates of considerable interest as possible pre-programmed events.
- Help explain evolution at the molecular level, and understand how certain mutations, or aberrant gene sorting and recombination, would have selective advantages for survival, or lead to failure.
- Characterize and identify genetic differences in humans in different environments, differences between man and other life forms, and differences between seemingly closely

related plants or animals. It would, therefore, be extremely valuable in studies of comparative biology, systematics and taxonomy.

- Put human toxicology and environmental and industrial regulatory policies on a firmer scientific basis.

Clinical Medicine -- A complete gene map would:

- Locate genes causing human diseases. There are more than 3,000 different genes on chromosomes related to human disease but with few exceptions, they have not been "located" or "placed," and their structure, function and regulation are poorly, if at all, understood.

- Make possible a broad range of definitive diagnostic tests now possible for some diseases such as Huntington's disease, Duchenne muscular dystrophy and cystic fibrosis in some families. While diagnosis is possible and usable for genetic counseling of prospective parents, the functions of the defective genes and their relations to symptoms, and how to treat these diseases are largely unknown.

- Greatly enhance prospects for somatic gene therapy, i.e., replacement of the defective gene, in those whose disease is normally fatal.

- Profoundly increase our understanding of radiation and chemical damage and its repair in the genome; of human neoplasia, pulmonary fibrosing disorders, genetically determined kidney pathologies, the range of human arthritic pathologies, auto-immune and immune deficiency diseases, and of psychiatric disorders some of which are demonstrably more frequent in families.

Industrial Developments -- Human gene maping/sequencing would expand:

- Prospects for new commercial products made from human genes. Several human gene products already in commercial production were first developed using recombinant DNA -- insulin, interferons and interleukins.

- The likelihood of direct application of the knowledge gained to produce livestock and agricultural commodities more efficiently and more resistant to disease and environmental stresses because the methods for human gene mapping and sequencing are equally useful to plant and animal scientists.

- Sales of at least laboratory and pilot scale automation and robotics for routine cell and chromosome sorting, and equipment for sequencing and synthesizing proteins and nucleic acids.

c. The answer to b., above, implies a broad range of interests and activities in several agencies. Current studies by the Office of Technology Assessment and the National Academy of Sciences (Board on Basic Biology) are focusing discussions on the scientific issues, logistics, organization, costs, likely progress and its projected rate. By the end of 1987, we will have a clearer idea of the pros and cons and possible consequences of proposed options. These might include pressing for a dedicated national effort to produce a physical map of the human genome.

Meanwhile, DoE, NIH and NSF are in close contact and the desirability of formal coordination is under active consideration by the Domestic Policy Council Working Group on Biotechnology.

Current research projects at the National Laboratories offer important precedents for cooperation. The chromosome specific gene library was developed under DOE auspicies, and is being distributed to the biomedical community with NIH support. The mapping project, which is a logical continuation of the gene library project, could proceed similarly--with DOE producing the ordered fragments, and NIH distributing them to the user community.

Another precedent for successful cooperation involves analysis and distribution of computerized sequence data. Los Alamos scientists, with the support of DOE's predecessors, have pioneered methods to analyze sequences. More recently, the

National Institute of General Medical Sciences, in a cooperative agreement with the Department of Energy, established GENBANK which receives multi-agency support for the acquisition and computer storage of nucleic acid sequences. Support for GENBANK will likely double in the immediate future and several agencies including NIH and DOE are expected to contribute to this expansion. Beyond this, however, DOE will support the development of new methodologies for structuring, retrieving, and analyzing the vast amounts of data that will be generated as a result of the genome initiative. DOE and NSF are also discussing the possiblity of developing one or more university-private sector-National Laboratory consortia which would be appropriate to the Administration's overall science and technology policy objectives.

NSF/NIH BUDGET

QUESTION: The proposal to double the NSF budget must necessarily be compared with the Administration's proposals in recent years to level off the budget for health-related research in the NIH. How can we justify such disparate priorities?

ANSWER: The Administration proposes a doubling of NSF's budget (to $3.4 billion) by 1992 which is congruent with its theme for competitiveness and the strong advice rendered by the White House Science Council in its report, A Renewed Partnership. The proposed increases for NSF respond to the report's conclusion that the ability of colleges and universities to fulfill their role in forefront science and engineering research and education has seriously eroded. The report also noted:

> "Our future position in global markets will...depend on our willingness to respond to opportunity and to mobilize our strengths today. To this end we must promote a broad interdisciplinary approach to problem-solving by focusing on university-based centers that will improve cooperative linkages between scientists, engineers and industry."

Under Chairman Fuqua, last year the House Committee on Science and Technology held hearings on the WHSC report, heard testimony from its principal architects, David Packard and D. Allen Bromley, and commended the Council on its excellent report. Chairman Fuqua said: "its importance to the future of America is clear..." (Hearing before the Task Force on Science Policy, House Science and Tech Committee, May 15, 1986; Publication No. 107.)

In comparing the Congressional appropriations of NIH and NSF, there is strong coincidence in their rates of increase. From 1980 through 1987, the NIH budget grew from $3.4 billion to $6.2 billion, an increase of 82%. Over the same period, NSF's budget grew from $0.88 billion to $1.6 billion, an increase of 82%.

For FY 1988, the Administration proposes obligations of $9.1 billion for all basic research, and obligations for basic research in the life sciences of $4.3 billion. The latter accounts for 47% of all basic research. Within

the life sciences category, NIH accounts for 80% of the total basic research obligations. The Administration recognizes the value to the nation of life science research; AIDS is among its highest priorities in health. It has proposed a strongly increased budget to stop the spread of the AIDS epidemic and to find a cure for AIDS. Obligations for AIDS have risen 100-fold since 1982 and more than doubled (counting the FY 1988 request) since 1986. The increase in FY 1988 proposed is 28% over FY 1987. About 60% of the FY 1988 obligations is allocated to NIH.

Strict comparisons between NIH and NSF are not easily made because the nature of their missions is so different; the span of the sciences, and the engineering and educational activities of NSF are extremely broad. In view of the WHSC report's findings and recommendations, the breadth of mission of NSF and the fact that almost one-half of all Federal basic research obligations is allocated to life sciences, the Administration is concerned about strengthening universities in the life sciences not primarily funded by NIH, in the physical sciences and engineering, and in developing human resources.

OSTP/INTERAGENCY RELATIONSHIPS

QUESTION: Several years ago the White House Science Council recommended that salaries at federal labs be raised and that more discretion be given to management. Such an experiment will begin at the National Bureau of Standards (NBS) by next year. Do you believe the NBS or China Lake experiments should be extended to other labs? Should personnel policy changes at federal labs be pursued separately from a comprehensive overhaul of the entire federal personnel system?

ANSWER: OSTP believes that Federal R&D researchers should be paid according to merit, and we support the WHSC recommendation to that effect. Such a change will, of course, require a de-emphasis on formula salary increases based upon longevity, will require more discretion and evaluation by management, and should proceed as expeditiously as possible within the federal personnel system.

QUESTION: The global geosciences initiative is a sweeping national and international undertaking. Some agencies, such as NSF, seem to be receiving most of the funding they need for this project, while others, such as NOAA, are struggling. What priority does this program have? What can be done to better coordinate funding levels? To what degree is our program being developed in concert with other nations?

ANSWER: Global geosciences is a high priority program designed to increase our understanding of the Earth as an interacting system. The initiative includes space missions such as Global Geospace science proposed for the NASA budget, the NOAA TOGA (Tropical Oceans Global Atmosphere) program, and studies in basic earth sciences at NSF. The program is being coordinated with international programs, such as the World Climate Research Program and the International Geosphere-Biosphere Program.

QUESTION: Numerous proposals have been floated to create an agency that concentrates specifically and solely on technological advance and economic competitiveness. Do you support any of these proposals? Is a Department of Science and Technology needed? Are there any alterations you would make in the current bureaucratic structure? Should NSF focus more or less than it does

now on technology and economic competitiveness? To what degree should industrial needs be considered in awarding grants for such programs as engineering research centers?

ANSWER: I do not see a need to create a new agency or department for science and technology at this time. The NSF is continuing its efforts to foster closer cooperation between industries and universities, for example, through the growth in the number of Engineering Research Centers. I support this and other efforts to have industries' views heard on science and engineering programs at universities and to find ways to transfer new knowledge and technologies in a timely manner from our universities and national laboratories into U.S. industries.

QUESTION: For many years various innovative re-structuring ideas have surfaced. As science policy advisor, would you enlighten us as to your own views about:

a. A Department of Science and Technology.

b. A separate National Technology Foundation analogous to the National Science Foundation.

c. A Federal University to serve as a model and bell-wether for university-level instruction in disciplines vital to our national interests.

d. A more visible administrative position within the Department of Education for dealing with and speaking for our universities as a national system of universities.

ANSWER:

a. A Department of Science and Technology is unwarranted at the present time.

b. I believe the support for technology development by the Federal Government is best addressed by the agencies.

c. Our diverse educational system has served the U.S. well and there is no reason to involve the Federal Government.

d. See c.

QUESTION: On February 17, 1983, the OSTP announced the creation of a White House Science Council, composed of 15 scientists, to assess major policy issues and advise OSTP. Do you intend to keep this Council in place? If so, what major issues do you see for the Council's immediate attention? Will the membership of the council change in any way? If no, do you intend to create a new advisory council?

ANSWER: The White House Science Council continues to provide advice and counsel to me on major policy issues in the science and technology arena. I do intend to keep the Council in place and have asked the Council to review a variety of issues of major importance to the science community at large.

While the members of the Council serve at the pleasure of the Science Adviser, at this time I do not anticipate any changes in the membership.

Since I became Director of OSTP, the Science Council has met twice to discuss a variety of issues of significant importance. The meetings have covered topics ranging from AIDS to the Semiconductor industry and the importance to domestic industry of a strong market viability.

QUESTION: What is the current number of full-time professionals at OSTP? How many of these are on detail from other agencies? What effect have budgetary cuts had on the ability of OSTP to meet its statutory responsibilities?

ANSWER: The total number of full-time professionals with OSTP is 30. Of those 7 are full-time permanent, and 23 are on detail from 10 different agencies.

Since the beginning of tenure OSTP has consistently provided the President, the Office of Management and Budge, and the National Security Council with a wide range of advice and counsel. As the entire federal government is faced with significant financial constraints, all agencies must adhere to their statutory requirements. Since my tenure began, OSTP has met its statutory responsibilities and I expect to continue to do so throughout my tenure.

PACKARD-BROMLEY REPORT

QUESTION: The White House Science Council's Packard/Bromley report recommended many actions to improve American universities, including merit scholarships, a facilities fund, and more rapid indirect costs reimbursement for facilities. What steps are being taken to implement these proposals?

ANSWER: The President has asked for $64.8 billion for R&D funding for FY 88, including $1.7 billion in obligations for the conduct of R&D at the National Science Foundation, an increase of 17 percent over FY 1987.

The NSF budget provides substantially increased support ($273 million) for the NSF Graduate Fellowship Program, and for the Presidential Young Investigators Program. A major increase for undergraduate programs will provide important new opportunities for faculty enhancement, student research participation, and for much needed instrumentation. The request includes $529 million for Basic Science and Technology Centers and Groups including increases for the Engineering Research Centers and Advanced Scientific Computing Centers and for the initiation in 1988 of a new program to expand the concept of the Engineering Centers to other fields of science such as biology, materials science, and computer and information sciences. As many as 15 such centers may be started in 1988.

The OMB and representatives of the universities have reached a compromise on indirect costs that does not include more rapid reimbursement for facilities.

Our work in implementing the recommendations of the Packard/Bromley report is by no means finished. It is a project that will continue for the rest of this administration, and I hope for the rest of this century.

QUESTION: The Packard/Bromley Report calls for a $5 billion federal effort to rebuild the nation's university research facilities.

a. How does the Administration propose to address this recommendation?

b. How can we address our competitive problems if inadequate university research facilities are severely restricting the creativity and productivity of university scientists?

ANSWER: The recommendation in the Packard/Bromley Report called for $5 billion over ten years. There is no question about the need for such an investment, but it must be weighed against other priorities in the federal budget. Given those priorities, it has not been possible to initiate a new program for facilities at this time.

Although our university research infrastructure is not in the state-of-the-art condition that we prefer, to say that it severely restricts the creativity and productivity of university scientists is an exaggeration. The quality of research facilities is only one aspect of the competitiveness issue.

RESEARCH AND DEVELOPMENT

QUESTION: What percentage of U.S. engineers and scientists work on military projects?

ANSWER: A generally accepted figure is that about one in seven, or 14 percent, of the nation's scientists and engineers work a majority of their time on national defense projects.

QUESTION: When the Reagan Administration came into office, the ratio of Federal support for military R&D to civilian R&D was about one-to-one. The ratio is now three-to-one. Do you find this to be an appropriate emphasis? What direction do you expect for this ratio in the long-range future?

ANSWER: In 1980 military R&D was funded at $13.6B and civilian R&D at $14.5B. The 1988 budget request funds military R&D at $46.6B and civilian R&D at $18.2. A comparison of the two rates of growth as a measure of Administration priorities is not a valid basis for drawing conclusions. Clearly, defense has been the Administration's highest priority, but civilian research and development has also been a priority, especially considering that many accounts have experienced no growth or a much slower rate of growth during the same period. As this Administration and succeeding Administrations focus on the issue of competitiveness and the role that Federally funded civilian R&D plays in fostering increased industrial competitiveness, funding for these programs will receive even higher priority. Regardless, a comparison with the funding level of defense R&D leads to an inaccurate assessment of the priorities these accounts occupy within the Administration's overall program.

QUESTION: What is the relationship between OSTP and DoD with respect to defense research initiatives? How does the Administration decide what a proper balance is between civilian and defense research funding?

ANSWER: For major defense-related initiatives, OSTP reviews the pertinent technology base at the time of program budget reviews. If discrepancies or potentially constructive synergies are discovered, these are brought to the attention of the agency protagonists. Competitive approaches to eliminate or to reduce technical risks are explored, compared, and selected to be part of the mainstream programs.

The implementation and Congressional support of the URI receive the particular attention of OSTP.

There is not a requirement for a balance (nor any doctrinal way of deciding on a proper balance) between civilian and defense research funding. For this reason the Administration does not see the two programs in competition for funds, facilities, or scientific personnel. The Administration is taking action to increase the resourcing of civilian research, but not at the expense of defense research.

QUESTION: Do you believe that the Defense Department, especially the SDI office, is investing adequately in basic research; in particular, university-based basic research?

ANSWER: The FY 88 budget request resources Department of Defense spending for technology base programs at $3.345B, of which $907M is for basic research, an increase of approximately 5 percent over FY 87. It is difficult to answer how much needs to be spent on the tech base and basic research. However, I do believe that DoD must significantly increase its support of basic research. The emphasis on competitiveness and the greater reliance of our military forces on high technology will place increased demands on the national security tech base in years ahead.

Historically, about 50 percent of DoD's basic research program goes to universities. The same percentage applies to the SDI Innovative Science and Technology Program. The balance between university, laboratory, and industry defense basic research programs seems to be productive and complimentary to the overall Administration basic research program. However, the universities' share of basic research funds is not as well defended and, therefore, must receive protection.

The SDI office has requested $5.2B for its 6.3A program. The SDI effort is unique in that it is basically a research program with 40 to 50 percent of its funds going to research and technology development. The portion of the SDI budget allocated specifically to basic research must, however, maintain steady growth and receive protection as SDI emphasis shifts to technology development.

QUESTION: About one year ago, OSTP was charged with coordinating Federal research into the phenomenon of "nuclear winter"--the severe global cooling which would follow any large nuclear exchange.

a. What are current and projected funding levels for this program?

b. Have university scientists become increasingly involved in the research, or is the bulk of the R&D still conducted inside the Defense Department?

c. What is the status of cooperative research on nuclear winter between the U.S. and the U.S.S.R.?

d. Is there any evidence that the Defense Department has incorporated the nuclear winter findings into its strategic planning?

ANSWER: Although much popular literature has been written about "nuclear winter," the scope and severity of the environmental effects of a nuclear war remain uncertain for cogent scientific reasons. Early in 1985, the Administration established a coordinated interagency research program to address the uncertainties in the "nuclear winter" hypothesis. University scientists, contractors and government laboratories are now investigating smoke microphysics, modeling climates, and conducting fire research with government funding.

a. The funding for this research in FY87 is $5,750,000 with the same amount projected for FY88.

b. The majority of the research is being done outside of DoD by contractors, universities and the national laboratories. The FY86 expenditures by end performer of the research are:

		END PERFORMER			
Funding Agency	Total	Contractor	Government Laboratories	Universities	In House
DoE	$2,500,000	-	$2,200,000	$ 280,000	-
DoD	$2,500,000	$1,070,000	$ 430,000	$1,000,000	-
NSF	$ 500,000	-	$ 500,000	-	-
NOAA	$ 250,000	-	-	-	$250,000

c. Those portions of "nuclear winter" basic research that do not compromise national security are discussed regularly with Soviet scientists at the working level under the auspices of the EPA-administered, US-USSR Agreement on Cooperation in the Field of Environmental Protection. No formal "Nuclear Winter Research Program" with the Soviet Union has been established, in part because of the September 1985 Committee on Exchanges' assessment that, "significant technology loss is possible, and there is little or no technological gain for the U.S."

d. The Defense Department has not incorporated "nuclear winter" findings into its strategic planning due the uncertainties in the hypothesis. Given the range of uncertainties in the source term for obscurants and

other parameters it is conceivable that changes to strategic plans based on current information could make the "nuclear winter" hypothesis more, rather than less, probable.

QUESTION: The U.S. spends less on civilian R&D as a percentage of GNP than Japan and Germany.

a. What does this budget do to change this situation?

b. Will the Administration propose any changes in the tax code to encourage private investment in R&D?

ANSWER: The Administration proposed an increase of 3% in Federal expenditures on non-defense R&D spending and proposes to stabilize the current 20% tax credit on new R&D expenditures by private industry.

QUESTION: Under the President's proposal, what will be the percentage decline in Federal civilian R&D? The increase for defense R&D?

ANSWER: In budget outlays, the President's proposed budget requests increased R&D funding for both Federal civilian R&D and defense R&D. The increases are 3 percent for civilian R&D and 11 percent for defense R&D.

QUESTION: If basic research is so important, why does it increase only 4.3% under the Administration's proposal while defense R&D grows substantially higher?

ANSWER: The Administration has identified defense as its top priority. However, non-defense R&D also holds a high priority and the President's FY 88 budget reflects that priority by proposing to increase federal expenditures in this area. Because of a need to decrease the overall federal deficit, most other areas are constrained in the FY 88 budget.

QUESTION: Can you tell us how the geosciences increase of $45 million in the NSF budget relates to the DOE program request within Basic Energy Sciences? Is the NSF add-on intended "to take up slack" for the geosciences research activities which can no longer be funded by DOE?

ANSWER: There is no intent for NSF "to take up slack" for geosciences research activities which are not funded by DOE. The DOE and NSF programs focus on different research areas that are complementary. Contract monitors at NSF have significant communications with their counterparts at DOE. The result is that little overlap occurs and the contract monitors remind one another when obvious areas of omission occur. When the President's budget is prepared each year, we ask each agency to make an independent assessment of funds it will need to carry out its mission, and proposed programs are reviewed by OSTP to ensure that they are compatible with agency missions.

SPACE

QUESTION: There has been considerable concern in the space science community that space science is taking a low priority in the wake of the loss of Challenger. The present proposal from the administration is to further delay the launch of the Mars Observer spacecraft until 1992. As you know, we will celebrate the 500th Anniversary of the discovery of the new world by Christopher Columbus with an International Space Year. If the Mars Observer were launched in 1990, as the Congress has already directed, we would have a data stream coming from Mars throughout 1992. Would you support a 1990 launch on a Titan 34-D-7?

ANSWER: Funding for continued planetary research missions such as the Mars Observer is an important priority within NASA. However, the Challenger accident and budgetary limitations have forced the agency to make some hard decisions on project priorities, and I support their present priorities.

QUESTION: The fiscal year 1988 budget request includes a major increase in funding for the Space Station. How are the negotiations with our proposed international partners going?

ANSWER: As expected, the negotiations have been difficult for this complex and long-term space system. I believe a successful agreement will be reached.

QUESTION: The Report of the National Commission on Space, the Paine Commission, included a imaginative long-range series of goals for the civil space program. How do you view that Proposal?

ANSWER: NASA needs a well enunciated, overarching goal to focus its activities toward its traditional role as an R&D agency. The National Commission on Space has laid out a wide range of visionary goals for the next 50 years. I believe the report over-emphasizes the "colonization of the solar system" compared to the research as exploration elements of the report. The Administration is carefully reviewing the report to identify near-term actions that are necessary to maintain the U.S. leadership in space science and exploration.

QUESTION: How do you see the balance between the military and civil space programs in this country?

ANSWER: The national security space program and the civil space programs are focused on goals appropriate to each sector. The balance between the programs is set by these goals.

QUESTION: Last year the Congress included in the NASA Authorization Act a revised National Space Council. Unfortunately, that legislation was vetoed. The proposed council was a Congressional response to what we perceived as major problems within the Administration in addressing questions of space policy. Let me ask for your personal views on that proposed National Space Council, and on the difficulties in resolving questions of space policy within the administration?

ANSWER: My office is looking at several possible options that might streamline the space policymaking process. Until I have had an opportunity to study the options, I am not able to answer your questions.

QUESTION: Last year we included in the vetoed NASA Authorization Act a Space Shuttle launch policy which clearly included the strong belief in both Houses of the Congress, that commercial payloads should be able to fly on the Space Shuttle after all governmental launch requirements are satisfied. What are your personal views on that proposal?

ANSWER: The Presidential policy requires that most commercial payloads not be launched on the shuttle, and the customers have been apprised of this fact. A small number of commercial payloads with national security or foreign policy implications continues to be manifested in the shuttle. I concur with this policy.

QUESTION: Last week the Air Force announced that they were awarding their Medium Launch Vehicle procurement to the McDonnell-Douglas DELTA. How do you see the development of a domestic commercial ELV industry with both the DELTA and TITAN production being busy?

ANSWER: The Air Force awarded the MLV contract to McDonnell-Douglas with the understanding that the MLV could also be used in the commercial ELV industry. I do not see the ELV production rate as a principal limitation to its commercial viability.

QUESTION: We understand that in the near future the administration will make a decision on what our launch strategy should be in the future. What are your

views on continued total reliance on the STS versus a mixed fleet strategy?

ANSWER: The Challenger accident and its aftermath has demonstrated that total reliance on the STS does not assure access to space. The civil space program as well as the national security program will require a mixed fleet strategy.

QUESTION: How does the overall United States space program compare and contrast with the Soviet space program? Is it an area which should concern us?

ANSWER: A comparison of the overall civil and national security space program and the Soviet space program shows the U.S. to be well ahead. The Soviets currently have a lead in expendable launch vehicles and in the Space Station arena; but if we continue with a well-defined U.S. Space Station program we will again establish our lead in these areas.

QUESTION: What is OSTP's future role in space policy making? Is OSTP looking into asserting itself into coordinating multi-agency space policy development?

ANSWER: OSTP remains the focus for the development of science and technology policy within the Administration, and the office will continue to play a central role in space policy development, consistent with its legislative charter.

QUESTION: The NASA Authorization bill that was passed by Congress last year was vetoed by the President. What was the principal objection to this legislation?

ANSWER: As the President pointed out in his veto message, he believes that it is his prerogative to decide on the organizational structure of the Executive Office. The NASA Authorization bill attempted to dictate that organization.

QUESTION: In the absence of some positive action on the part of the Administration to coordinate civil space issues, it is likely that Congress will once again propose the establishment of a Space Council. Will you recommend an Administration initiative in this area?

ANSWER: As noted in answer to an earlier question, my office is looking at possible options that might streamline the space policy making process. Until I have had an opportunity to study the options, I am not able to answer your questions.

QUESTION: What will be the impact on space science programs if the Shuttle launch is delayed? What contingency plans have been made? Would the Administration consider a reordering of priorities--possibly delaying some military launches or putting some military payloads on ELVs?

ANSWER: If the Shuttle recovery process is delayed, the entire manifest will slip to later dates, with internal adjustments made for critical launches. If it becomes clear that the first launch of the newly redesigned shuttle will be delayed, then the Administration will review the full range of requirements and will address the question of how each payload will be accommodated. With or without shuttle delays, ELVs will play an increasing role in meeting our national launch needs.

QUESTION: How has the Challenger accident affected the pool of technical talent in the space program? NASA manpower? University? Has NASA's ability to hire top talent been affected?

ANSWER: There is not yet a noticeable impact on the talent pool in the space program from the Challenger accident, but there is considerable cause for concern. We hear that some professors are cautioning new graduate students about undertaking space science research. We must continue to work to expand our launch opportunities and to shorten the time between experiment concept and completion.

QUESTION: Could you identify the programs that have been most seriously impacted by the loss of launch capability? Which programs are most seriously threatened? For example, are there satellites with critical life spans that need to be replaced?

ANSWER: Both the civil and defense programs have been seriously impacted by the lack of launch capability, and this is reflected in the difficulty in establishing launch priorities. Launch of the next TDRSS is a high priority, critical item.

QUESTION: What is the Administration's position with regard to including private citizens in future shuttle missions? Explain.

ANSWER: At the present time, the shuttle manifest does not include any missions that would fly a private citizen. After we are fully satisfied that the system has recovered, we will reopen the question of including private citizens.

QUESTION: What is the Administration's position with regard to developing an interim shuttle? That is a near-term replacement for the existing shuttle prior to the readiness of the technology that is being developed through the national aerospace plane program? (Note: Ivan Bekey was quoted in a Dec 1, 1986 article in Aviation Week, that the existing fleet will not need to be replaced until 2010 at the earliest; however, a less expensive manned vehicle might be needed before the current fleet wears out.)

ANSWER: It is unlikely that a new manned shuttle can be justified prior to the end of the useful life of the current shuttle system unless some breakthrough occurs that would drastically lower the cost of access to space. The next generation shuttle whether it will be the aerospace plane, rocket or a combination, will depend on the most viable technology at the time a decision is made to replace the shuttle.

QUESTION: Now that NASA is presumably getting out of the commercial launch business, what will the Administration's position be if the private sector can't compete with foreign competitors such as Ariane? Isn't it in the national interest to retain this market even if some help from the government is needed?

ANSWER: It certainly is in the national interest to retain the commercial market and I believe that we will see U.S. commercial ELVs successfully competing in this area. Removal of the shuttle from the competition was viewed as the necessary first step, and was strongly supported by the U.S. ELV industry.

QUESTION: Is there enough launch business for more than one company?

ANSWER: Yes. The variety of commercial launch requirements will most likely mandate more than one launch system.

QUESTION: How can we assure open competition among the potential participants? (e.g. now that McDonnell Douglas has won the MLV contract, will other contractors be able to compete for the small amount of commercial business?)

ANSWER: McDonnell Douglas is clearly in an excellent position to compete for the smaller payloads. However, there are a number of requirements beyond the Delta II class launch capability and we have a lot of entrepreneurs who are working hard to enter this market.

QUESTION: Would the Administration support the formation of consortiums to provide commercial launch services if the alternatives are letting the business go to the

Ariane or getting NASA back into the commercial launch business?

ANSWER: I think it is too early to consider consortiums beyond inter-industry cooperation that is already legally possible.

QUESTION: What are the major impediments to a healthy commercial ELV industry? Can the government help in mitigating some of the risk?

ANSWER: The Economic Policy Council's Commercial Space Working Group is continuing to identify potential show-stoppers. The major concerns expressed by the industry included:

A clear and concise Administration policy promoting commercial ELVs.

Sufficient government business to cover start-up costs.

Access to government launch facilities at a fair price.

Adequate insurance.

A level playing field with regard to foreign launch providers.

QUESTION: Is it the Administration's view that NASA should move toward being more of an R&D agency with less emphasis on space flight operations?

ANSWER: Yes.

QUESTION: Will the new NASA organization resulting from the Phillips' study accomplish the Administration's objectives? Doesn't this organization place even more emphasis on operations? (Note: A new AA for Space Flight Operations has been established.)

ANSWER: The NASA reorganization will accomplish the Administration's objectives. The new organization proposes an Associate Administrator for space flight operations sometime in the future. That organizational move will provide a mechanism to develop a comprehensive plan for managing NASA space flight operators, and will not be implemented until shuttle recovery is complete.

QUESTION: For the past few years the aeronautics field has had a positive balance of trade in the international market. This has been in the neighborhood of $14 billion.

a. Do you think that it is important to continue to fund aeronautics research and development so that United States industry will remain competitive worldwide?

b. Would you support an increase in aeronautics research budgets in order to maintain U.S. competitiveness? Please explain.

ANSWER: Aerospace remains a shining star in the U.S. trade picture with over $10 billion trade surplus in 1986. However, foreign competition is gaining a foothold. Foreign products now dominate world sales in general aviation, commuter aircraft and rotorcraft, and the AIRBUS is achieving significant market penetration with their high-technology transport aircraft. It is essential that aeronautics R&D continue to increase so the U.S. can sustain its lead in this area.

QUESTION: The President's budget for NASA does not include funding for expendable launch vehicles in order to achieve a "mixed fleet" space transportation system. When will we see such a budget request? Would OSTP support a supplemental budget request to get started on a mixed fleet?

ANSWER: NASA has recently completed a mixed fleet study and is evaluating the budget implications. OSTP is generally supportive of the mixed fleet concept, but will evaluate its position when the final report is available.

QUESTION: The aviation industry is one of our few remaining export winners. Yet NASA's Aeronautical Research and Technology Program, one of the key drivers of this record success, has actually declined in terms of purchasing power during the '80's. Shouldn't we be expanding this area of research in light of our current concern with international competitiveness?

ANSWER: It is essential that aeronautics R&D continue to be strong so the U.S. can retain its lead in this area. NASA is a major player in the research and development for the National Aerospace Plane Program and is increasing its budgetary support for this important hypervelocity flight regime.

QUESTION: The President's budget over the past several years has failed to include funding for the Advanced Communications Technology Satellite Program. Does this signify a deemphasis in space applications programs that have direct private sector benefits?

ANSWER: The Government will continue to play a role in advanced space R&D programs with broad private sector benefits where the risks are sufficiently high that it's unreasonable to expect the private sector to make the initial R&D investment.

QUESTION: The Department of Defense has begun to identify many needs for space transportation and facilities that are in common with those of NASA. In view of this, how can we maintain a distinct and separate civilian space program?

ANSWER: It is clear that we cannot afford to duplicate facilities that will, in fact, meet both DOD and NASA needs. The civilian space program must remain separate and can do so by focusing on R&D--that is, by concentrating on advancing technology, on space science and exploration and on stimulating space enterprise. As in the past, NASA will cooperate with the DOD in using our national resources when it is in the national interest to do so.

QUESTION: The National Commission on Space has recommended that we establish a National Space Laboratory to be responsible for planning and coordinating space-based laboratory facilities. What is your view of this proposal? How can we otherwise coordinate the space related activities of NASA, DOE, NOAA, USGA, and other agencies?

ANSWER: OSTP supports the establishment of an effective process to utilize the ideas and capabilities of all U.S. agencies in the Space Station era. NASA has already initiated an in-house study to establish such a process.

QUESTION: How can we restructure the space policy-making mechanism in the Executive Office so that timely and balanced decisions can be made?

ANSWER: As a result of the space policy changes resulting from the Challenger accident, we are reviewing policy issues within OSTP.

QUESTION: What steps need to be taken to organize a truly productive international Space Year?

ANSWER: NASA is leading an interagency effort to address this question and OSTP is participating in this effort. The Space Science Board of the National Academy of Sciences is studying U.S scientific participation; the International Council of Scientific Unions is addressing the international scientific aspects; and, other organizations are exploring additional ideas for

the ISY. These activities will provide answers to your question over the coming months.

QUESTION: In your presentation of the President's budget you characterized the fiscal year 1987 budget for NASA as an increase for science. Aside from major hardware programs, such as, the Station and the Shuttle, how much of an increase is there for Space Science and Applications programs?

ANSWER: In Budget Authority, the space science and applications budget increased by 6% between FY 86 and FY 87.

QUESTION: In response to the FY 1987 Continuing Appropriations bill, the Department of Commerce recently submitted to the Congress a plan to continue commercialization of civilian remote-sensing (Landsat). While it is encouraging that OMB has, for the first time, approved funding for Landsat commercialization, it appears likely that funding will not be sufficient to enable the private contractor (EOSAT) to compete effectively in the international marketplace.

a. What role has OSTP played in development and approval of the Landsat commercialization plan?

b. Do you believe the plan as submitted will be effective?

c. P.L. 98-365 ("Land Remote-Sensing Commercialization Act of 1984") mandated that NASA and NOAA submit to Congress a long-range plan for remote-sensing R&D. This plan, now 19 months late, has never been submitted. Why not? Isn't this delay characteristic of the confusion in Federal policy toward space commercialization?

ANSWER: a. OSTP has stayed informed on this plan, but the primary responsibility for putting it into effect rests with the Department of Commerce.

b. Yes, it will be effective.

c. See item A.

QUESTION: Last month, the Navy abruptly cancelled the Navy Remote Ocean Sensing System (NROSS) program, a dedicated ocean satellite program which was originally projected to have significant operational military benefits, particularly in the area of anti-submarine warfare. The cancellation of what is really a national program will also have serious repercussions on NASA (which is building one of the NROSS instruments), on NSF (which funds ocean satellite research), and on NOAA (which was gearing up to supply NROSS data to ocean industries).

ANSWER: The cancellation of NROSS does affect our national oceanographic research and development programs and my

office is reviewing possible approaches to retaining the most important R&D elements of the program.

QUESTION: NASA is currently negotiating with the European Space Agency, Canada, and Japan about respective roles in the Space Station project. The discussions have been difficult, particularly those related to autonomy of the players during the operational phases of the station.

a. Has OSTP been involved in these discussions?

b. What is your view of the prospects for a fruitful agreement?

c. What is your view of the appropriate level of international participation in the Station program?

d. What is your view of the appropriate level of international participation in large Fedoral science projects in general?

ANSWER: OSTP has been involved in the interagency and international aspects of Space Station. It is our assessment that the international partners want to participate and agreements will be reached after some hard negotiations. The Space Station is fundamentally a U.S. concept and the U.S. is providing most of the resources. We should retain a clear leadership role in the program. International participation in other federal science projects must be considered on a case-by-case basis taking into account such issues as the goals of the project and the uniqueness of the foreign contribution.

QUESTION: Dr. Graham, as you know, both defense and civilian needs ultimately require that the U.S. generate much more electrical power for space missions and this means nuclear reactors in space. I hope that you will be using your good office to insure that when these technologies are ready, all significant safety testing and risk assessment studies will have been done so that the country can go forward in space applications in a much more unconstrained fashion. Do you have any plans in this regard?

ANSWER: I am aware of the need for continued nuclear power systems in space where solar power systems are not adequate--that is where survivability is an issue and in deep space. We have been reviewing the agency development processes for space nuclear systems.

QUESTION: Dr. Graham, I understand that DOD has requested supplemental funding for '87 including $125 million for a Heavy Lift Launch Vehicle in order to meet SDIO requirements.

Would you tell us how this relates to Second Generation Shuttle development and the National Aerospace Plane (NASP) and what will NASA's role be in the unmanned Heavy Lift Launch Vehicle activity?

ANSWER: By Presidential direction, the nation's future launch requirements and implementation options are under review by a joint NASA and DOD study team, and all three of these systems are included in the study.

US-USSR S&T COOPERATION

QUESTION: When disarmament discussions were resumed with the Soviet Union at Geneva, and President Reagan met with Gorbachev at Geneva to begin those talks, there was much talk about broadening science cooperation with the U.S.S.R. Where do we stand today in this area? In what fields do we have cooperation, and are there plans for an expansion or contraction of such cooperation?

ANSWER: Currently the U.S. has government-to-government bilateral science agreements with the Soviet Union in the following areas:

- Atomic Energy
- Agriculture
- Environmental Protection
- Public Health and Medicine
- Housing
- Oceans

We also have a "General Agreement on Contacts, Exchanges and Cooperation in Scientific, Technical, Educational, Cultural and Other Fields," administered by USIA. Additionally, the National Academy of Sciences has a non-governmental agreement with the Soviet Academy of Science, which is partially funded by NSF.

Several recent interactions have taken place in accordance with the President's call in June 1984 for an expansion of U.S.-Soviet S&T interaction, as well as his Geneva Agreement with Gorbachev that there be broader exchanges in general between the U.S. and Soviet Union. As we proceed with the Soviets in such cooperative programs, our major objectives are to produce a scientific pay-off for the U.S., while protecting sensitive technology that would contribute to the Soviet military.